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GOTTFRIED WILHELM LEIBNIZ

Philosophical Papers and Letters

A Selection Translated and Edited, with an Introduction by
LEROY E. LOEMKER

VOLUME II

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INTRODUCTION

To judge from his own willingness to publish his opinions, and the works which he later mentions with approval, the mature period of Leibniz's thought begins with the *Meditations on Knowledge, Truth, and Ideas* (Vol. I, No. 32). It is only after his return from Italy in 1690, however, that such fundamental concepts as those of individuality, force, the intercourse between monads, and the gradations of substance are analyzed in detail. The year 1690 may therefore be regarded as the line of demarcation between Leibniz's early period of eclecticism and discovery and his mature system. Yet his thought cannot be regarded as either complete or stable, even in this last period of about twenty-five years. Indeed, as old age sets in, his complaints increase for the lack of time and peace of mind to complete and to perfect; and he never abandons his cautious eagerness to test his new ideas by submitting them, first of all, to his friends and critics.

The first decade of this period, roughly coextensive with the 1690's, itself involves a fundamental shift in his philosophical interests. Newton's *Principia,* reaching him in Italy, arouses his zeal to complete his own dynamics, with the result that his thinking is permanently shifted from an emphasis upon the universal harmony to a concern for the individual. The logical foundations are neglected for an explicit dynamism, the theory of causality developed earlier is applied in more detail to the mind-body problem, a priorism recedes into the background and an a posteriori argument for God is perfected, and the claim to demonstrate gives way to the recognition that his philosophy is hypothetical. The climax of this change is 1695, when the *Specimen dynamicum* and the *New System* are published; and the controversies which these works arouse continue until Leibniz's death and, indeed, far beyond, metaphysical issues crystallizing first, and scientific ones taking form more slowly but becoming the more bitter as they grow.

The death of the Elector Ernest August on January 23, 1698, weakened Leibniz's position at the court at Hanover at the very time when his European reputation and influence were highest and his scientific and diplomatic successes had been felt in all the great centers—London, Berlin, Vienna, Paris, and St. Petersburg. The history of the House of Brunswick, in which his third Hanoverian master, George Louis (after 1714, George I of England), set such stock, began increasingly to confine his intellectual activities. Yet the intensity of his other studies did not diminish; his journeys grew more frequent; projects for inventions, societies, alliances, settlements, and unifications continued to be formulated, some of them to be carried out; and intrigues ensnared him to the extent that prolonged philosophical work became less possible than ever.

Leibniz's achievements in this field are remarkable, however, even in this period. The great efforts at synthesis, however incomplete, are behind him. Most of his philosophical writing belongs in the areas, first of popularization, and then of controversy. The queen of Prussia, his illustrious and capable pupil and friend, called forth some of his better expositions, and the Theodicy, published in 1710, five years after her death, was a monument to her intellectual and religious interests. Even the controversy in which he was engaged at his death with Clarke and Newton was continued with another royal reader in mind, Caroline of Anspach, the princess of Wales, who mediated the letters. Meanwhile he sought to establish his ideas, and perhaps himself, in England through correspondence with Lady Masham, Gilbert and Thomas Burnet, and Pierre Coste (the translator of Locke, Shaftesbury, and other English authors), while such works as the Principles of Nature and of Grace, apparently written for Eugene of Savoy in Vienna but sent to a Parisian group as well, and the

Monadology were designed to persuade or enlighten a popular following on the Continent. Leibniz was still in earnest about the intellectual unity of Europe and about the noble support upon which he believed this unity depended.

Popularization did not exclude controversy, however, or more critical efforts to perfect his system, particularly the concept of individual substance. Indeed, Leibniz seemed no longer able to do protracted philosophical writing except when continuity was provided by the works he was refuting; the two great monuments of the period were running commentaries and refutations of others: Locke in the New Essays and Bayle in the Theodicy. The two series of letters, one to the Scholastic Cartesian De Volder, the other to the Scholastic Jesuit Des Bosses, span the last period of Leibniz's thought and together constitute a prolonged effort to attain clarity on the nature of individual substance and to formulate it convincingly for others. Leibniz's style achieves its height only in this period. The ponderous erudition of his earlier writings is left behind, at least sometimes, and a more perfect harmony or "consent" appears between meaning and expression. The Monadology is by no means an adequate statement of his philosophy, but it is nonetheless the layman's best outline of his metaphysics.

PART III

HANOVER TO THE DEATH OF ERNEST AUGUST

1690–98

38

Letter to Arnauld

Venice, March 23, 1690

At the end of his long journey to Austria and Italy in quest of materials for the history of the House of Brunswick, Leibniz once more tried to resume his philosophical correspondence with Antoine Arnauld. Though the Italian stay had been filled with historical and practical interests, more theoretical work had not entirely lagged. The most important fruit of the period was the preparation of a work on physics, the *Dynamica de potentia et legibus naturae corporeae,* which he left with his friend Baron Bodenhausen in Florence. In March, 1690, he prepared a summary of his philosophical opinions for the Cartesian Platonist, Michelangelo Fardella, editor of St. Augustine's works. To Arnauld he sent essentially the same summary in this letter. Arnauld did not answer, and the correspondence ended.

* * *

[G., II, 134-38]

I am now about to return home after a long journey undertaken by order of my prince for the purpose of historical investigations. In its course I have found patents, titles, and indubitable proofs adequate to confirm the common origin of the noble houses of Brunswick and Este, upon which Justel, Du Cange, and others were right in casting doubts, because there were contradictions and errors on the matter in the historians of Este, together with a complete confusion of times and persons. At present I plan to return and once more take up my old routine. Having written to you two years ago, shortly before my departure,[1] I am taking that same liberty in order to inquire after your health and to let you know that the thought of your outstanding merit is always in my mind. While in Rome I saw a new letter denounced which was attributed to you or to your friends. And I have since seen the letter of the Reverend Father Mabillon to one of my friends, in which he says that the Reverend Father Le Tellier's defense of the missionaries against the practical morality of the Jesuits has given several people a favorable impression of this order but that he had heard that you have replied to it and that it is said that you have annihilated the reasons of this father geometrically. All this has convinced me that you are still in a position to render the public a service,[2] and I pray God that this may be so for a long time. It is true that I have an interest in this, but it is a laudable one, for it will provide me with a means of instruction, whether in common with all the others who will read your works, or when your criticisms instruct me in particular—if the limited leisure which you have permits me still to hope for this privilege occasionally.

Since this journey has enabled me in part to dismiss from my mind ordinary occupations, I have had the satisfaction of conversing with many able men of science and learning, and I have communicated my particular ideas, with which you are acquainted, to some of them in order to profit by their doubts and difficulties. There were some among them who, dissatisfied with the usual doctrines, found an unusual satisfaction in certain opinions of mine. This has led me to put them in writing so that they can be communicated more easily, and some day, perhaps, I shall have some copies printed without my name, solely in order to send them to my friends for the purpose of receiving their criticism. I wish that you could examine them first, and it is for this that I have made the following summary of them.

The body is an aggregate of substances; it is not, properly speaking, one substance. Consequently, there must be found throughout the body indivisible substances incapable of generation and corruption, corresponding somewhat to souls. All these substances have always been, and will always be, united to organic bodies capable of diverse transformations. Each of these substances contains in its nature a *law of the continuation of the series of its own operations*[3] and everything that has happened and will happen to it. Except for its dependence upon God, all its actions come from its own depths. Each substance expresses the universe, as a whole, but one does it more distinctly than another, each one pre-eminently with regard to certain things and according to its point of view. The union of the soul with the body, and even the operation of one substance on another, consists only in this perfect mutual accord, explicitly established by the order of the original creation, in virtue of which each substance, following its own laws, agrees with the demands of the others, and the operations of the one thus follow or accompany the activity or change of the others. Intelligences or souls capable of reflection and of knowing the eternal truths and God have many privileges which exempt them from the upheavals of bodies. For them moral laws must be joined with the physical. All things have been made principally for them. Together they form the commonwealth of the universe, whose monarch is God. There is a perfect justice and order observed in this city of God, and there is no evil action without punishment or good action without a proportional reward. The more thoroughly one understands things, the more beautiful one finds them, and the more conformable with the wishes which a wise man could make. One must always be content with the order of the past, since it is in absolute conformity with the will of God, which we know from its outcome. But we must try to make the future, as much as depends on us, conform to the presumptive will of God or to his commandments—to adorn our Sparta, and to labor in well-doing, yet without being cast down when success escapes us, in the firm faith that God will know how to find the most proper time for changes for the good. Those who are not content with the order of things cannot claim to love God as they ought. Justice is nothing but the charity of the wise man. Charity is a benevolence that is universal, which the wise man carries into execution in conformity with the measures of reason, to the end of obtaining the greatest good. And wisdom is the science of happiness or of the means of arriving at a lasting contentment, which consists of a continuous progression toward a greater perfection or at least in the variation of a same degree of perfection.

As concerns physics, we must understand the nature of force; that it is entirely different from motion, which is something more relative. This force must be measured by the quantity of the effect. There is an absolute force, a force of direction, and a relative force.[4] Each of these forces is conserved in the same quantity, in the universe or in each machine which has no communication with others, and the two last forces taken together compose the first, or absolute force. But the same quantity of motion is not conserved, for I show that otherwise perpetual motion would be discovered, and the effect would be more powerful than its cause.

Some time ago I published in the Leipzig *Acts* an essay in physics in which I seek the physical causes of the motions of stars. As a basis I propose that all motion of a solid in the fluid, which takes place in a curved path or whose velocity is varied continuously, comes from the motion of the fluid itself. From this I conclude that the stars have orbits that are deferent but fluid.[5] I have demonstrated an important general theorem: that every body which moves in harmonic revolution (that is, in such a way that, as the distances from the center vary in arithmetic progression, the velocities are in harmonic progression or reciprocal to the distances) and which, moreover, has a paracentric motion, that is, one determined by gravity or levity with reference to the same center (whatever the law of this attraction or repulsion may be), moves with areas necessarily proportional to the times, in the way which Kepler observed in planets. Then, taking into consideration, *from observations*, that the motion is elliptical, I find that the law of paracentric motion combined with the harmonic revolution described in ellipses must be such that gravitation is reciprocally proportional to the squares of the distances, like the radiations from the sun.[6]

I shall say nothing to you about my calculus of increments or differences, by which I find tangents without removing irrational numbers and fractions, even when the unknown is involved in them, and by which I subject quadratures and transcendental problems to analysis. Nor shall I speak of an entirely new analysis, belonging to geometry and entirely different from algebra,[7] and still less of some other matters on which I have not yet had time to present essays. I should have hoped to be able to explain these all to you in a few words in order to have your opinion, which would be of incalculable value to me, if you had as much leisure as I have deference for your judgment. But your time is precious, and my letter is already long enough. Therefore I end it here and am with zeal, etc.

39

ON THE METHOD OF DISTINGUISHING REAL FROM IMAGINARY PHENOMENA

Date Unknown

Though the date of this study on the criterion for testing truths of fact is unknown, it presupposes the viewpoint of the *Meditations on Knowledge, Truth, and Ideas* and the *Discourse on Metaphysics* (Vol. I, Nos. 33 and 35) but supplements the former by discussing the tests for the validity of phenomena. At the end, however, it moves toward clearer notions of body and of force, such as were developed in the 1690's. As a statement of Leibniz's phenomenalism it may be compared with the letter to Foucher in 1675 and the Paris notes relating to it (Nos. 11 and 13) and to the *Dialogue* of 1677 (No. 17). But the argument for a real, harmonious order and particularly the argument for the existence of other minds, are much more fully developed.

* * *

[G., VII, 319-22]

A *being* is that whose concept involves something positive or that which can be conceived by us provided what we conceive is possible and involves no contradiction. We know this, first, if the concept is explained perfectly and involves nothing confused, but then in a shorter way, if the thing actually exists, since what exists must certainly be a being or be possible.

Just as being is revealed through a distinct concept, however, so existence is revealed through a distinct perception. To understand this better, we must see by what means existence may be proved. In the first place, I judge without proof, from a simple perception or experience, that those things exist of which I am conscious within me. These are, first, myself who am thinking of a variety of things and, then, the varied phenomena or appearances which exist in my mind. Since both of these, namely, are perceived immediately by the mind without the intervention of anything else, they can be accepted without question, and it is exactly as certain that there exists in my mind the appearance of a golden mountain or of a centaur when I dream of these, as it is that I who am dreaming exist, for both are included in the one fact that it is certain that a centaur appears to me.

Let us now see by what criteria we may know which phenomena are real. We may judge this both from the phenomenon itself and from the phenomena which are antecedent and consequent to it as well. We conclude it from the phenomenon itself if it is vivid, complex, and internally coherent [congruum]. It will be vivid if its qualities, such as light, color, and warmth, appear intense enough. It will be complex if these qualities are varied and support our undertaking many experiments and new observations; for example, if we experience in a phenomenon not merely colors but also sounds, odors, and qualities of taste and touch, and this both in the phenomenon as a whole and in its various parts which we can further treat according to causes. Such a long chain of observations is usually begun by design and selectively and usually occurs neither in dreams nor in those imaginings which memory or fantasy present, in which the image is mostly vague and disappears while we are examining it. A phenomenon will be coherent when it consists of many phenomena, for which a reason can be given either within themselves or by some sufficiently simple hypothesis common to them; next, it is coherent if it conforms to the customary nature of other phenomena which have repeatedly occurred to us, so that its parts have the same position, order, and outcome in relation to the phenomenon which similar phenomena have had. Otherwise phenomena will be suspect, for, if we were to see men moving through the air astride the hippogryphs of Ariostus, it would, I believe, make us uncertain whether we were dreaming or awake.

But this criterion can be referred back to another general class of tests drawn from preceding phenomena. The present phenomenon must be coherent with these if, namely, it preserves the same consistency or if a reason can be supplied for it from preceding phenomena or if all together are coherent with the same hypothesis, as if with a common cause. But certainly a most valid criterion is a consensus with the whole sequence of life, especially if many others affirm the same thing to be coherent with their phenomena also, for it is not only probable but certain, as I will show directly, that other substances exist which are similar to us. Yet the most powerful criterion of the reality of phenomena, sufficient even by itself, is success in predicting future phenomena from past and present ones, whether that prediction is based upon a reason, upon a hypothesis that was previously successful, or upon the customary consistency of things as observed previously.[8] Indeed, even if this whole life were said to be only a dream, and the visible world only a phantasm, I should call this dream or this phantasm real enough if we were never deceived by it when we make good use of reason. But, just as we know from these marks which phenomena should be seen as real, so we also conclude, on the contrary, that any phenomena which conflict with those that we judge to be real, and likewise those whose fallacy we can understand from their causes, are merely apparent.

We must admit it to be true that the criteria for real phenomena thus far offered, even when taken together, are not demonstrative, even though they have the greatest probability; or, to speak popularly, that they provide a moral certainty but do not establish a metaphysical certainty, so that to affirm the contrary would involve a contradiction. Thus by no argument can it be demonstrated absolutely that bodies exist, nor is there anything to prevent certain well-ordered dreams from being the objects of our mind, which we judge to be true and which, because of their accord with each other, are equivalent to truth so far as practice is concerned. Nor is the argument which is popularly offered, that this makes God a deceiver, of great importance. At least no one will fail to see how far it is from a demonstration having metaphysical certainty, for we are deceived not by God but by our judgment, asserting something without accurate proof. And though a great probability may be involved, nevertheless God, in offering us this probability, is not therefore a deceiver. For what if our nature happened to be incapable of real phenomena? Then indeed God ought not so much to be blamed as to be thanked, for, since these phenomena could not be real, God would, by causing them at least to be in agreement, be providing us with something equally as valuable in all the practice of life as would be real phenomena. What if this whole short life, indeed, were only some long dream and we should awake at death, as the Platonists seem to think? Since we are destined for eternity, and this whole life, even if it were to contain many thousands of years, would be like a point with respect to eternity, how trifling a thing is this small dream, to be interposed upon such fulness of truth, to which its relation is less than that of a dream to a lifetime. Yet no reasonable person calls God a deceiver if some short dream which is completely distinct and coherent is experienced in the mind.

So far I have spoken of appearances; now we must examine those things which do not appear but which nevertheless can be inferred from appearances. It is indeed certain that every phenomenon has some cause. But if anyone says that the cause of phenomena is in the nature of our mind which contains the phenomena, he will affirm nothing false, but nevertheless he will not be telling the whole truth. For in the first place, there must necessarily be a reason why we ourselves exist rather than not. And even if we are assumed to have existed from eternity, we should still have to find a reason for eternal existence, and this reason must be sought either within the essence of our mind or outside of it. And certainly there is nothing to prevent innumerable other minds from existing as well as ours, although not all possible minds exist. This I demonstrate from the fact that all existing things are in intercourse with each other. However, minds of another nature than ours can be conceived which also have[9] intercourse with ours here. That all existing things have this intercourse with each other can be proved, moreover, from the fact that otherwise no one could say whether anything is taking place in existence now or not, so that there would be no truth or falsehood for such a proposition. But this is absurd, because there are no[10] extrinsic denominations, and no one becomes a widower in India by the death of his wife in Europe unless a real change occurs in him. For every predicate is in fact contained in the nature of a subject. Now, if some possible minds exist, the question is: Why not all? Furthermore, since all existence necessarily is in intercourse, there is necessarily a cause of this intercourse; indeed, everything must necessarily express the same nature but in a different way. But the cause which leads all minds to have intercourse with each other or to express the same nature, and therefore to exist, is that cause which perfectly expresses the universe, namely, God. It does not have a similar cause and is unique. Hence it is at once clear that there exist many minds besides ours, and, since it is easy to think that men who converse with us can have exactly the same reason to doubt our existence as we have to doubt theirs; and, since no reason operates more strongly for us than for them, they will also exist and have minds. Thus both sacred and profane history, and indeed whatever pertains to the status of minds or rational substances, may be considered confirmed.

Concerning bodies I can demonstrate that not merely light, heat, color, and similar qualities are apparent but also motion, figure, and extension. And that, if anything is real, it is solely the force of acting and suffering, and hence that the substance of a body consists in this (as if in matter and form). Those bodies, however, which have no substantial form, are merely phenomena or at least only aggregates of the true ones.

Substances have metaphysical matter or passive power insofar as they express something confusedly; active, insofar as they express it distinctly.[11]

40

ON THE TRUE *THEOLOGIA MYSTICA*

Ca. 1690(?)

This religious interpretation of Leibniz's thought is written in German and reveals his skill in finding a popular terminology for his metaphysical concepts (so, for example, *Selbstbestand* for "substance," *Unwesen* for "matter," etc.), a practice he had urged in the Preface to Nizolius many years earlier and for which he had pointed out the advantages of German. Though Guhrauer, who printed it in his collection of Leibniz's German writings, may have claimed too much by calling it a confession, no work serves better to reveal the Platonic pattern of Leibniz's religious thinking, and nowhere is the intellectualistic quality of what has been called his mysticism more apparent. Guhrauer dates it in the last ten or fifteen years of the seventeenth century.

* * *

[Guh. DS., I, 410-13]

Every perfection flows immediately from God, as essence, power, existence, spirit, knowledge, will.[12]

Only the inner light which God himself kindles in us has the power to give us a right knowledge of God.

The divine perfections are concealed in all things, but very few know how to discover them there.[13]

Hence there are many who are learned without being illumined, because they believe not God or the light but only their earthly teachers or their external senses and so remain in the contemplation of imperfections. This light does not come from without, although external teaching can, and sometimes must, give us an opportunity to get a glimpse of it.

Among these external teachers there are two which best awaken the inner light:[14] the Holy Scriptures and the experience of nature. But neither of these helps us if the inner light does not work with them. (The knowledge of God is the beginning of wisdom, and the divine attributes are the primary truths for the right order of knowledge.)

The essential light is the eternal Word of God, in which is all wisdom, all light, indeed the original of all beings and the origin of all truth. Without the radiation of this light no one achieves true faith, and without true faith no one attains blessedness.

God is the easiest and the hardest being to know; the first and easiest in the way of light; the hardest and last in the way of shadows.

Most knowledge and invention [Tichten] belongs to the shadow way, such as history, languages, the customs of man and of nature. There is also some light in these shadows, but few can separate the light from the darkness.

This light fills the mind [Gemüth] with clarity and assurance but not with images and vain motions. There are some who imagine a world of light in their brains and think that they behold the brilliance and splendor and are surrounded by many thousands of little lights. But this is not the true light but only a heating of their blood.[15]

When anyone sees the true light, he is convinced that it is of God and not of the flesh or devil. Just as the sun bears witness of itself, so also does this light.

All creatures derive from God and from nothingness [Nichts]. Their self-being [Selbstwesen] is of God, their nonbeing [Unwesen] is of nothing. (Numbers too show this in a wonderful way, and the essences of things are like numbers.)[16]

No creature can be without nonbeing; otherwise it would be God. Angels and saints must have it.

The only self-knowledge is to distinguish well between our self-being and our nonbeing (and so to prevent our straying from the way of light. But one must make use of sensual things [Ergetzlichkeiten] and must view the shadow pictures only as an aid or a tool and not rest in them).

Within our self-being there lies an infinity, a footprint or reflection of the omniscience and omnipresence of God.

Every single self-state [Selbststand], such as I or you, is a unified, indivisible, indestructible thing and does not consist of three parts: soul, spirit, and body. Yet there is a diversity of things which belong directly to the one being and are, as it were, embodied in it.

Although every single self-state is without parts, yet other things are impressed in it without thereby taking up any space in it. In each and every being there is everything——but with a certain degree of clearness.

Bodies are the mere work of God; spirits are essentially the kingdom of God.

God belongs to me more intimately than my body. (Bodies in themselves are no self-states but shadows which flow away.) Corporeal things are but shadows which flow away, glimpses, shapes, truly dreams. Essential truth is in the spirit alone. But inexperienced men take the spiritual for a dream and what is tangible for the truth.

Sin is not from God, but original sin has arisen in some creatures from their nonbeing and hence out of nothingness.

God has permitted sin because he knows how to bring a greater good out of evil. Only the evil themselves have suffered any loss through sin; the whole creation of God has not lost but gained through it. (God does not have an unconditioned will to power [Machtwille] but wills everything with a cause and for the best. Election by his grace [*Gnadenwahl*] has its origin in his foreknowledge of the worth of men and therefore not in his foreknowledge of their faith or their works but from much higher causes. For if a man believes, or says, or thinks, or does anything good, this is a result of God's foreseen election of him in Christ.) For one unimportant thing added to another can often produce something better than can two things added together which are in themselves more precious than either of the others. It is here that the secret of the election of grace lies hidden and that its knot is to be untied. *Duo irregularia possunt aliquando facere aliquid regulare.*[17] God wills the salvation of all creatures and their best.

The denial of self is the hatred of the nonbeing which is in us and the love of the origin of our self-being, or God.

"Crucifying the old Adam," drawing near to Christ, dying to Adam and living in Christ—all these consist in this: that we deny nonbeing and cling to self-being.

Whoever understands how to prefer the inner light to its images, or self-being to nonbeing, loves God above all things.

He who merely fears God loves himself and his nonbeing more than God.

Faith without knowledge comes not of the spirit of God but of the dead letter or the empty echo.

Faith without light awakens no love but only fear or hope and is not living.

He who does not act according to his faith has no faith, even though he may boast of it. It is deplorable that so few people know what light and faith, love and life, Christ and blessedness, are.

Christ's teaching is spirit and truth, but many make of it flesh and shadow.

Most men have no earnestness. They have never tasted truth and are bogged down in a secret unbelief.

Let each examine himself whether he has faith and life. If he finds any other joy and pleasure greater than that in the love of God and the glorification of his will, he does not sufficiently know Christ and does not yet feel the prompting of the Holy Spirit.

Scripture gives us a beautiful test to determine whether a man loves God, namely, if he loves his brother and strives to serve others as far as he can. Whoever does not do this boasts falsely of his illumination or of Christ and the Holy Spirit.

41

A Study in the Logical Calculus

Early 1690's

This paper is one of several which mark the most advanced stage reached by Leibniz in his efforts to establish the rules for a logical calculus. They are certainly later than August, 1690, when he wrote the logical studies given in Cout. OF., pages 232-37 and 421-23. The fundamental logical relations are still identity or coincidence, inclusion or containment, and combination—still expressed as logical addition, as in the earlier paper given in Volume I (No. 26, I), from 1679. Leibniz's own title for a companion study, less complete than this one, but introducing also the relation of subtraction, which is missing here (cf. n. 18), was "An Example, Not Inelegant, of Demonstrating in Abstract Terms" (G., VII, 228).

* * *

[G., VII, 236-47]

Definition 1. *Same* or *coincident* terms are those which can be substituted for each other anywhere without affecting truth. For example, "triangle" and "trilateral," for in all the propositions demonstrated by Euclid about a triangle, *trilateral* can be substituted, and the converse, without affecting their truth.

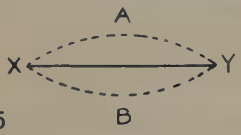

Fig. 15

A ∞ *B* signifies that *A* and *B* are the same; thus we may say of the straight lines *XY* and *YX*: *YX* ∞ *XY*, or the shortest distance of motion from X to Y and from Y to X coincides (Fig. 15).

Definition 2. Diverse terms are those which are not the same or in which substitution sometimes does not work. Such are the circle and the triangle, also the square (that is, the perfect square, as geometricians always understand it) and the equilateral quadrangle, for the latter can be said of the rhombus, which cannot however be called a square.

A non ∞ B signifies that A and B are diverse, as are the lines XY and RS (Fig. 16).

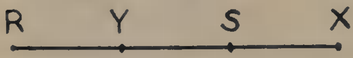

Fig. 16

Proposition 1. If A ∞ B, then also B ∞ A. If anything is the same as another thing, that other will be the same as it. For, since A ∞ B (by hypothesis) (by Def. 1), B can be substituted for A, and A for B in the statement A ∞ B (true by hypothesis); therefore, it follows that B ∞ A.

Proposition 2. If A non ∞ B, B is also non ∞ A. If one thing is diverse from another, the other will be diverse from the first. Otherwise B would be ∞ A. Then, however (by the preceding theorem), A would be ∞ B, which is contrary to hypothesis.

Proposition 3. If A ∞ B and B ∞ C, A will be ∞ C. Terms which are the same as a third term are the same as each other. For, if in the statement A ∞ B (true by hypothesis) C is substituted in place of B (by Def. 1, since B ∞ C), it follows that the proposition is true.

Corollary. If A ∞ B and B ∞ C, and C ∞ D, A will be ∞ D, and so forth. For A ∞ B ∞ C, therefore A ∞ C (by this proposition). Further A ∞ C ∞ D, therefore (by this proposition) A ∞ D.

Hence, since equals are the same in magnitude, the consequence is that terms equal to a third term are equal to each other. Euclid, to make an equilateral triangle, makes both sides equal to the base, with the result that they are equal to each other. If something is moved in a circle, it needs only to be shown that the paths of any two successive periods or rotations to the same point coincide with each other to conclude that the paths of any periods whatever coincide.

Proposition 4. *If* $A \infty B$ *and* B *non* ∞ C, A *non* ∞ C. *If one of two terms which are the same as each other is diverse from a third, the other is also diverse from the third.* For, if in the proposition B non ∞ C (true by hypothesis) A is substituted in place of B, the true proposition results that A non ∞ C.

Definition 3. A *is in* L or L *contains* A is the same, and L can be substituted for a plurality of terms taken together which includes A.

Definition 4. All things which contain whatever is in L are said together to be *components* with respect to L, and L is the *composed* or constituted.

$B \oplus N \infty L$ denotes that B is in L or that L contains B; but B and N together constitute or compose L. The same applies in the case of many terms.

Definition 5. *Subalternates* I call terms of which one is in the other; as A and B, if B is in A, or A is in B.

Definition 6. *Disparates* are terms of which neither is in the other.

Axiom 1. $B \oplus N \infty N \oplus B$, or transposition makes no difference here.

Postulate 1. Given any term whatever, something can be assumed to be diverse from it, and, if desired, disparate, or so that one is not in the other.

Postulate 2. Any number of terms whatever, such as A and B, can be added together into one, composing $A \oplus B$ or L.

Axiom 2. $A \oplus A \infty A$. If nothing new is added, nothing new results, or repetition changes nothing. (For though four coins and another four coins are obviously eight coins, this is not true of four coins and the same four coins counted again.)

Proposition 5. *If* A *is in* B, *and* $A \infty C$, C *is also in* B. *Whatever coincides with an inexistent is also inexistent.* For if we substitute C for A (by Def. 1, since $A \infty C$ by hypothesis) in the proposition A is in B (true by hypothesis) the result is that C is in B.

Proposition 6. *If* C *is in* B, *and* $A \infty B$, C *is also in* A. *Whatever* *is in one of two coincident terms is also in the other.* For substituting *A* for *C* (since *A* ∞ *C*), in the proposition *C* is in *B*, *A* is in *B*. (This is the converse of the preceding proposition.)

Proposition 7. A *is in* A. *Any term whatever is in itself.* For *A* is in *A* ⊕ *A* (by definition of inexistence or by Def. 3) and *A* ⊕ *A* ∞ *A* (by Axiom 2). Therefore (by Prop. 6) *A* is in *A*.

Proposition 8. *If* A ∞ B, A *is in* B. *One of two coincidents is in the other.* This is clear from the preceding proposition, for, according to it, *A* is in *A*, that is (by hypothesis), in *B*.

Proposition 9. *If* A ∞ B, A ⊕ C ∞ B ⊕ C. *If coincident terms are added to the same term, the results coincide.* For if you substitute for *A* its coincident *B* (by Def. 1) in the proposition *A* ⊕ *C* ∞ *A* ⊕ *C* (true in itself), the result is that *A* ⊕ *C* ∞ *B* ⊕ *C* (Fig. 17).

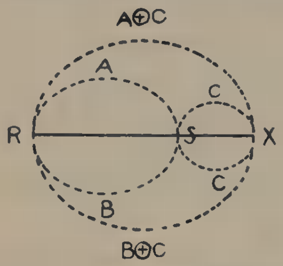

Fig. 17

A triangle
B trilateral } coincide;

A + *C* equilateral triangle
B + *C* equilateral trilateral } coincide.

Scholium. This proposition cannot be converted, much less the following two. In the problem of Proposition 25 below, a way will be taught to show this at once.

Proposition 10. *If* A ∞ L *and* B ∞ M, A ⊕ B ∞ L ⊕ M. *If coincidents are added to coincidents, the results are coincident.* For, since *B* ∞ *M*, *A* ⊕ *B* will be ∞ *A* ⊕ *M* by the preceding theorem; and substituting *L* for the second *A* (since *A* ∞ *L* by hypothesis), *A* ⊕ *B* ∞ *L* ⊕ *M*. *A*, a triangle, and *L*, a trilateral, coincide. *B*, regular, and *M*, the largest area with the same perimeter and same number of sides, coincide. A regular triangle and a trilateral making the largest area of any three-sided figure with the same perimeter coincide (Fig. 18).

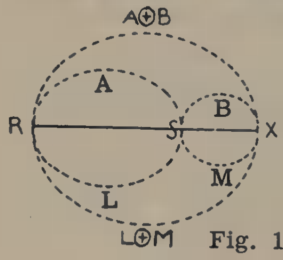

Fig. 18

Scholium. This proposition cannot

be converted, for if A ⊕ B ∞ L ⊕ M and A ∞ L, it does not follow that B ∞ M. And much less can the following proposition be converted.[18]

Proposition 11. If A ∞ L and B ∞ M and C ∞ N, A ⊕ B ⊕ C ∞ L ⊕ M ⊕ N, and so forth. If there is any number whatever of terms and some of them coincide with an equal number of others, term for term, any term composed of the former will coincide with a term composed of the latter. For (by the preceding proposition, since A ∞ L and B ∞ M) it will follow that A ⊕ B ∞ L ⊕ M. Hence, since C ∞ N, it follows further by the preceding that A ⊕ B ⊕ C ∞ L ⊕ M ⊕ N.

Proposition 12. If B is in L, A ⊕ B will be in A ⊕ L. If the same term be added to the contained and the container, the former result will be contained in the latter. For let L ∞ B + N (by definition of inexistence); then A ⊕ B is in B ⊕ N ⊕ A (by the same definition), that is, in L ⊕ A.

Let B be equilateral, L regular, A quadrilateral. Equilateral is in or is a part of regular. Therefore quadrilateral equilateral is in quadrilateral regular or perfect square. YS is in RS. Therefore RT ⊕ YS or RS is in RT ⊕ RX, or in RX (Fig. 19).

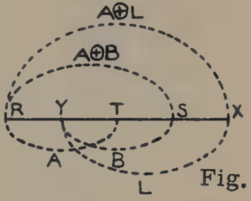

Fig. 19

Scholium. This proposition cannot be converted, for if A ⊕ B is in A ⊕ L, it does not follow that B is in L.

Proposition 13. If L ⊕ B ∞ L, B will be in L. If any term with another added to it does not become another term, the thing added is in it. For B is in L ⊕ B (by definition of inexistence) and L ⊕ B ∞ L (by hypothesis). Therefore (by Prop. 6) B is in L.

RY ⊕ RX ∞ RX; therefore, RY is in RX.

RY is in RX; therefore, RY ⊕ RX ∞ RX.

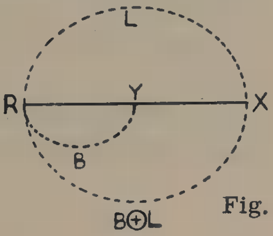

Fig. 20

Let L be a parallelogram (whose opposite sides are parallel) and B a quadrilateral. A quadrilateral parallelogram is the same as parallelogram; therefore, quadrilateral is in parallelogram. On the other hand, quadrilateral is in parallelogram; therefore, quadrilateral parallelogram is the same as a parallelogram (Fig. 20).

Proposition 14. *If* B *is in* L, $L \oplus B \infty L$. *Subalternates compose nothing new, or, if what is in another term is added to it, it makes nothing more than the term itself.* This is the converse of the preceding. If B is in L, $L \infty B \oplus P$ (by definition of inexistence). Therefore (by Prop. 9), $L \oplus B \infty B \oplus P \oplus B$, that is (by Axiom 2) $\infty B + P$, which is (by hypothesis) ∞L.

Proposition 15. *If* A *is in* B *and* B *is in* C, A *is also in* C. *A term contained in a contained term is contained in its container.* For A is in B (by hypothesis); therefore $A \oplus L \infty B$ (by definition of inexistence). Similarly since B is in C, $B \oplus M$ will be ∞C. Substituting $A \oplus L$ (which we showed to coincide with it) for B in this assertion, it follows that $A \oplus L \oplus M \infty C$. Therefore (by definition of inexistence), A is in C (Fig. 21).

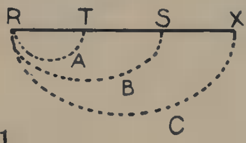

Fig. 21

RT is in RS and RS is in RX. Therefore, RT is in RX. Let A be be quadrilateral, B a parallelogram, and C a rectangle. To be a quadrilateral is in parallelogram, and to be a parallelogram is in rectangle (that is, a figure all of whose angles are right). Therefore, to be a quadrilateral is in rectangle. These can be inverted, if in place of the notions considered in themselves we consider the individuals comprehended in the notion, and let A be rectangle, B parallelogram, and C quadrilateral. For all rectangles are comprehended in the number of parallelograms, and all parallelograms in the number of quadrilaterals. Hence, all rectangles are contained in quadrilaterals. In the same way all men are contained in all animals, and all animals in all corporeal substances; therefore all men are contained in all corporeal substances. But, on the contrary, the notion of corporeal substance is in the notion of animal, and the notion of animal is in the notion of man. For to be a man contains to be an animal.

Scholium. This proposition cannot be converted, and the following even less so.

Corollary. If A ⊕ N is in B, N also is in B. For N is in A ⊕ N (by definition of inexistence).

Proposition 16. If A is in B, and B is in C, and C is in D, A is also in D, and so forth. A term contained in one contained is contained in the container. For if A is in B and B is in C, A is in C (by the preceding proposition).

Proposition 17. If A is in B and B is in A, A ∞ B. Terms which contain each other coincide. For if A is in B, A ⊕ N ∞ B (by definition of inexistence) (Fig. 22). Now B is in A (by hypothesis; hence A ⊕ N is in A (by Prop. 5). Therefore (by corollary or Prop. 15), N is in A. Therefore (by Prop. 14), A ∞ A ⊕ N or A ∞ B. Let RT be N; RS, A; SR ⊕ RT, B. To be trilateral is in triangle, and to be triangle is in trilateral. Therefore triangle and trilateral coincide. Similarly to be omniscient is to be omnipotent.

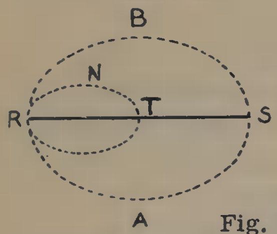

Fig. 22

Proposition 18. If A is in L, and B is in L, A ⊕ B is also in L. What is composed of two inexistents in the same term is in that same term. For, since A is in L (by Hypothesis), it can be understood that A ⊕ M ∞ L (by definition of inexistence). Similarly, since B is in L, it can be understood that B ⊕ N ∞ L. Combining these, it follows (by Prop. 10) that A ⊕ M ⊕ B ⊕ N ∞ L + L (Fig. 23). Therefore (by Axiom 5), A ⊕ M ⊕ B ⊕ N ∞ L. Therefore (by definition of inexistence), A ⊕ B is in L. Thus RYS is in RX. YST is in RX. Therefore, RT is in RX.

Let A be equiangular; B equilateral; A ⊕ B equiangular equilateral, or regular; L square. Equiangular is in square; equilateral is in square. Therefore, regular is in square.

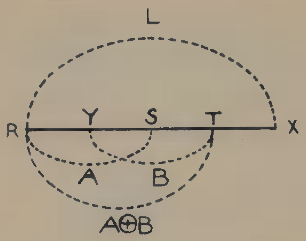

Fig. 23

Proposition 19. If A is in L and B is in L and C is in L, A ⊕ B ⊕ C will be in L, and so forth. Or, in general, if terms taken separately are in a term, their composite is also in it. For A ⊕ B is in L (by the preceding proposition). Now C is also in L (by hypothesis); therefore (also by the preceding proposition), A ⊕ B ⊕ C is in L.

Scholium. It is clear that these propositions and similar ones can be converted. For, if A + B ∞ L, it is clear from the definition of inexistents that A is in L and B is in L. Likewise if A + B + C ∞ L, it is clear that A is in L, and B is in L, and C is in L. Likewise A + B is in L, and A + C is in L, and B + C is in L, and so forth.

Proposition 20. If A is in M and B is in N, A ⊕ B will be in M ⊕ N. If one of two terms is in a third term, and the other is in another fourth term, the composite of the antecedent terms is in the composite of the two other terms. For A is in M (by hypothesis) and M is in M ⊕ N (by definition of inexistence). Therefore (by Prop. 15), A is in M ⊕ N. Similarly, since B is in N, and N is in M ⊕ N, B is in M ⊕ N. But if A is in M ⊕ N and B is in M ⊕ N, then (by Prop. 18) A ⊕ B is in M ⊕ N (Fig. 24).

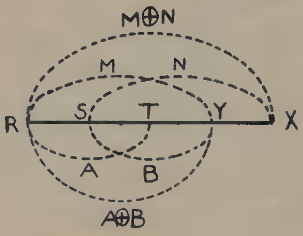

Fig. 24

RT is in RY and SY[19] in SX; therefore, RT ⊕ SY or RY is in RY ⊕ SX or RX.

Let A be quadrilateral, B equiangular; then A ⊕ B will be rectangular. Let M be a parallelogram, and N, regular, then M ⊕ N is a square. Now a quadrilateral is in parallelogram, and equiangular is in regular; therefore, rectangular (or equiangular quadrilateral) is in regular parallelogram or square.

Scholium. This proposition cannot be converted. Though A be in M, and also A ⊕ B in M ⊕ N, it does not always follow that B is in N, for it may happen that A as well as B is in M, or that some things which are in B are also in M and others in N. Hence the following proposition similar to it is even less convertible.

Proposition 21. If A is in M and B is in N, and C is in P, A ⊕ B ⊕ C is in M ⊕ N ⊕ P, and so forth. A composite of contained terms is in a composite of containing terms. For since A is in M and B is N, A ⊕ B is in M ⊕ N (by the preceding proposition). Further, since C is in P (again by the preceding proposition), A ⊕ B ⊕ C is in M ⊕ N ⊕ P.

Proposition 22. Given two disparate terms A and B, to find a third term C diverse from them which with them will form the subalternates A ⊕ C and B ⊕ C; that is, so that, though A and B are not in each other, A ⊕ C and B ⊕ C will be in each other.

Solution. If we wish A ⊕ C to be in B ⊕ C, though A is not in B, this can be done as follows: Assume something D (by Postulate 1) such that it is not in A, but making (by Postulate 2) A + D ∞ C, then what we seek has been accomplished (Fig. 25).

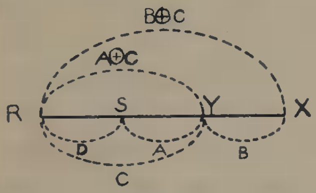

Fig. 25

For A ⊕ C ∞ A ⊕ A ⊕ D[20] (by construction) ∞ A ⊕ D (by Axiom 2). Similarly, B ⊕ C ∞ B ⊕ A ⊕ D (by construction). But A ⊕ D is in B ⊕ A ⊕ D (by Def. 3). Therefore, A ⊕ C is in B ⊕ C. Which was to be done.

SY and YX are disparate. Let RS ⊕ SY ∞ YR; then SY ⊕ YR will be in XY ⊕ YR.

Let A be equilateral, B parallelogram, D equiangular, C equilateral equiangular or regular. Then it is clear that, though equilateral and parallelogram are disparate so that neither is in the other, yet a regular equilateral is in a regular parallelogram or square. But, you say, this prescribed construction does not succeed in all cases of the problem. For example, let $\underline{A}$ be a trilateral, $\underline{B}$ a quadrilateral. Then no notion can be found such that $\underline{A}$ and $\underline{B}$ are both in it and that $\underline{A} \oplus \underline{C}$ is also in a given $\underline{B} \oplus \underline{C}$, since $\underline{A}$ and $\underline{B}$ are incompatibles. I reply that our general construction depends upon the second postulate, according to which something can be composed of anything whatever. Thus God, soul, body, point, and heat together constitute an aggregate of these five things. And so a quadrilateral and a trilateral can be compounded, and the problem solved. Assume $\underline{D}$ as anything which is not contained in a trilateral; let us say, a circle. Then $\underline{A} \oplus \underline{D}$ is a trilateral and a circle, which may be called $\underline{C}$. Then $\underline{C} \oplus \underline{A}$ is nothing again, but a trilateral and a circle. For in any case it is in $\underline{C} \oplus \underline{B}$, that is, in a trilateral, a circle, and a quadrilateral. But if anyone seeks to apply this general calculus of compounds of any kind whatsoever to some special type of compounding, for example, if someone wishes the trilateral and circle and quadrilateral not merely to compose an aggregate, but each as a concept to be in the same subject, he must see whether they are compatible. Thus immovable scattered straight lines may indeed be taken to compose one aggregate but not to compose a continuum.[21]

Proposition 23. *Given two disparate terms* A *and* B, *to find a third,* C, *diverse from them.*

Solution. Assume (by Postulate 2) that $\underline{C} \infty \underline{A} \oplus \underline{B}$, and the problem is solved. For since $\underline{A}$ and $\underline{B}$ are disparate (by hypothesis), that is, neither is in the other (by Def. 6), it follows that $\underline{C}$ cannot be $\infty \underline{A}$, nor $\underline{C} \infty \underline{B}$ (by Prop. 13). Therefore, these three terms are diverse, just as the problem presupposes. Furthermore, $\underline{A} \oplus \underline{C} \infty \underline{A} \oplus \underline{A} \oplus \underline{B}$ (by construction); that is, $\infty \underline{A} \oplus \underline{B}$ (by Axiom 2). Therefore, $\underline{A} \oplus \underline{C} \infty \underline{A} \oplus \underline{B}$, which was to be done.

Proposition 24. *To find any desired number of terms, each diverse from the others, and related to each other in such a way that no new term can be composed from them, nor a term diverse* *from any of them whatsoever.*

Solution. Assume A, B, C, and D to be any terms whatever diverse from each other (by Postulate 1). From them (by Postulate 2), let $A \oplus B \infty M$; $M \oplus C \infty N$: and $N \oplus D \infty P$. Then A, B, M, N, and P are the desired terms. For, by construction, M is made from A and B, and, furthermore, A or B is in M, and M is in N, N in P. Therefore, by Proposition 16, any of the prior terms is in any one of the posterior. Now, if you compound any two terms with each other, no new term is constituted. For, if you compound the same terms with itself, there is no new term. $L \oplus L \infty L$, by Axiom 2. But if you compound one with another, you compound an earlier with a later, and therefore an inexistent term with its container, as $L + N$. But $L + N \infty N$ (by Prop. 14). Now, if you compound three terms together, as $L + N + P$, you compound a binary, $L + N$, with one, P. But the binary $L + N$ in itself compounds nothing new but only one of its own terms, namely, the latter one, N, as I have already shown. Therefore to compound the binary $L + N$ with the one term P is the same as to compound the one term N with P, and, as I have just shown, compounds nothing new. Therefore, a binary together with one, or a ternary, compounds nothing new. And so on for many terms. Q. E. D.

Scholium. It would have sufficed to add terms continuously inexistent in themselves, as M, N, P, and this will indeed result if in our construction we set $A \infty$ nothing, and let $B \infty M$. But the given solution seems a little more inclusive. Undoubtedly all the problems so far could be solved in other ways. But to show all these possible solutions, that is, to prove that there are no other possible methods, would require that many more propositions should previously be proved. For example, five terms, A, B, C, D, and E, can have only the following methods of arrangement, so that no new term can be compounded from them: first, if A is in B, B in C, C in D, and D in E; second, if $A \oplus B \infty C$, and C is in D, and D in E; third, if $A \oplus B \infty C$, and A is in D, and $B \oplus D \infty E$. In this third or last mode, moreover, there are these five notions: equiangular A, equilateral B, regular C, rectangular D, square E. From these no new term can be compounded which does not already coincide with them, because equiangular and equilateral coincides with regular, and equiangular is in rectangular, and equilateral rectangular coincides with square. Hence equiangular regular is the same as regular and equilateral regular is also, and equiangular rectangular is rectangular, and regular rectangular is square.

Scholium to Definitions 3, 4, 5, and 6. We say that the notion of a genus is in the notion of a species but that the individuals of the species are in the individuals of the genus. The part is in the whole, and the indivisible is also in the continuum, as a point is in a line, even though a point is not a part of a line. Thus the notion of a modification or a predicate is in the notion of the subject. This consideration has in general the very widest application. We say too that inexistents are contained in the terms in which they are. In this connection it makes no difference to this general notion how the terms are in each other or in a container.[22] Thus our demonstrations also apply to those things which compose something distributively, as all species together compose a genus. Hence all the inexistents sufficient to constitute a container, or which contain all the terms which are in the container, are said to compose the container itself. For example, $A \oplus B$ is said to compose L, if A, B, and L signify straight lines RS, YX, RX, since $RS \oplus YX \infty RX$. Similarly $RS \oplus SX \infty RX$. Such parts which exhaust a whole, I usually call "cointegrants," especially if they have no part in common, in which case they may be called "comembers," as RS and RX. Hence it is clear that the same term can be composed in many ways, if the terms of which it is composed are further composite. Indeed, if they can be resolved into the infinite, the variations of composition are infinite. Thus analysis and synthesis together depend upon the foundations constructed here. Furthermore, if the terms which are contained are homogeneous with that in which they are contained, they are called "parts," and the container is called the "whole." If any two parts whatever are so related that a third can be found having a part of each in common, that which is composed of the three is a continuum. Thus it is clear how one consideration gradually arises out of another. Furthermore, I call terms of which one is in the other "subalternates"; for example species in a genus, and the straight line *RS* in the straight line *RX*. I call them "disparates" when this is not true; for example, the straight lines *RS* and *YX*, two species of the same genus, a perfect and an imperfect metal. This applies especially to members of diverse divisions of the same whole which have something in common; for example, if we divide metals into perfect and imperfect, and further into those which are soluble in aqua fortis and those insoluble in it, it is clear that a metal insoluble in aqua fortis and a perfect metal are two disparates and that there is a perfect metal, or one that fulminates, which remains in the retort which is yet soluble in aqua fortis, namely, silver, and that, on the other hand, there is an imperfect metal insoluble in aqua fortis, namely, tin.

Scholium to Axioms 1 and 2. Since the art of characteristics [*speciosa generalis*][23] is nothing but the representation and treatment of combinations by signs, and there are various conceivable laws of combination, the result is that various methods of compounding arise. Here, however, we take no account of variations which consist in merely changing the order of terms; *AB* is the same as *BA* for us. Furthermore, we also take no account here of repetition; *AA* is the same as *A* for us. Thus, wherever these laws are observed, the present calculus can be applied. But this calculus is clearly observed in the compounding of absolute concepts, where there is no ground for arrangement or for repetition; thus it is the same to say "warm and bright" as to say "bright and warm," and to say a "warm fire" or "white milk," as the poets do, is redundant, for white milk is nothing but milk and rational man merely rational animal, since rational is nothing but rational animal. The same holds when certain determinate things are said to exist in things. It is vain to add the same real more than once. When two and two are said to make four, the latter two must be diverse from the former two. If they were the same, they would produce nothing new. This would be like trying, in jest, to make six eggs out of three, by counting first the three eggs, then taking away one and counting the remaining two, and again taking away one and counting the remaining one. But in the calculus or numbers and magnitudes, $\underline{A}$ or $\underline{B}$ or any other signs do not signify a definite thing, but any cases whatever of the same number of congruent parts; for any two feet whatever are signified by 2 if the foot is the unit of measure. Hence $2 + 2$ make a new term 4, and 3 times 3 a new term 9; for it is always presupposed that diverse terms, though of the same magnitude, are involved. But the case if different in certain matters, for example, lines. Assume that a movable point draws a straight line, $\underline{RY} \oplus \underline{YX} \infty \underline{RYX}$, or $\underline{P} \oplus \underline{B} \infty \underline{L}$, extending from $\underline{R}$ to $\underline{Y}$ (Fig. 26). Let us assume then that the same point returns from $\underline{X}$ toward $\underline{Y}$ and stops there. Then, although it has twice described $\underline{YX}$ or $\underline{B}$, it has produced nothing more than if it had once described $\underline{YX}$. $\underline{L} \oplus \underline{B}$ is the same as $\underline{L}$, or $\underline{P} + \underline{B} + \underline{B}$ or $\underline{RY} \oplus \underline{YX} \oplus \underline{XY}$ is the same as $\underline{RY} \oplus \underline{YX}$. This warning is of great importance in estimating the magnitude of those things which are generated by the magnitude and motion of things generating or describing them. For here one must be careful not to have one part retrace another or to have one part of the describing line take the place of another; or we must subtract it in this case, so that the same term is not added more than once. It is also clear that, according to the notion used here, the magnitudes of components added together can constitute a magnitude greater than that of the thing which they compose. Thus the composition of terms and of magnitudes differs greatly. For example, if the whole line $\underline{L}$, or $\underline{RX}$, has two parts $\underline{A}$ or $\underline{RS}$, and

B or YX, of which each is greater than half of RX itself (for instance, if RX is 5 feet, RS is 4 feet, and YX is 3 feet), obviously the magnitudes of the parts will compose the magnitude of 7 feet, which is greater than that of the whole line, yet the lines RS and YX themselves compose only RX, or $RS \oplus YX \infty RX$. It is for this reason that I designate real addition by ⊕, while I designate the addition of magnitudes by + . Finally, it makes a big difference in real addition what the order is when we are dealing with the actual generation of things, for the foundation must be laid before the house is built. But in the mental formation of terms the result is the same, whatever ingredient we consider first, even though one method of consideration may be more useful than another. Hence order does not affect the development of the theory of this calculus. We shall have to consider order at the proper time. But now $RY \oplus YS \oplus SX$ is the same as $YS \oplus RY \oplus SX$.

Scholium to Proposition 24. RS and YX are diverse, and also disparate, so that neither is in the other. Let $RS \oplus YX \infty RX$; then $RS \oplus RX$ will be the same as $YX \oplus RX$. For the straight line RX is always compounded in its notions. Let A be a parallelogram, B equiangular, terms which are disparate. Let C be $A \oplus B$, that is, rectangular. Then rectangular parallelogram will be the same as equiangular rectangle, for neither is anything but rectangular. In general, let Maevius be A, Titius B, the pair of men composing C. Then Maevius will be one of this pair just as Titius will be one, and nothing will result but this pair on both sides. Another solution can be given to this which is more elegant and specialized, when A and B have something given in common and also have something that is distinctive of each. Thus let M be distinctive of A and N distinctive of B; make $M + N \infty D$; and let P be what is common to both. I say $A + D$ will be $\infty B + D$.

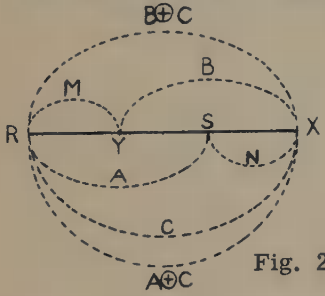

Fig. 26

For, since $\underline{A} \infty \underline{P} \oplus \underline{M}$, and $\underline{B} \infty \underline{P} \oplus \underline{N}$, $\underline{A} \oplus \underline{D}$ will be $\infty \underline{P} \oplus \underline{M} \oplus \underline{N}$, and $\underline{B} \oplus \underline{D}$ also will be $\infty \underline{P} \oplus \underline{M} \oplus \underline{N}$.

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CRITICAL THOUGHTS ON THE GENERAL PART OF THE PRINCIPLES OF DESCARTES

1692

The critical notes which Leibniz wrote to the first two parts of the Principia philosophiae were intended to be the nucleus for a definitive judgment on Descartes's entire system from Leibniz's point of view and therefore summarized and united all the special criticisms of particular points which he had been making for the previous twenty years. In 1692 Leibniz sent the manuscript to Basnage de Beauval in Holland, with instructions to find a publisher (an assignment which Basnage was unable to carry out) and at the same time to submit the notes to Huygens, Bayle, and other scholars for their criticism. Basnage kept the document until 1697, when he sent it to John Bernoulli at Groningen.

In the Principia philosophiae, Part I, Descartes had restated the general metaphysical position of the Meditations more exactly, following them in Part II with his conception of the nature of body and of motion. Thus Leibniz's notes on Part I are valuable for their sharp formulation of his own views on knowledge and truth and for his careful analysis of the psychological and epistemological nature of error. Part II is one of the best statements available of the methodological use which Leibniz makes of the principle of continuity in physics. The text is that of Leibniz's revision. Several readings from his first draft are printed in the notes.

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[G., IV, 354-92]

On Part I

On Article 1. Descartes's dictum that everything in which there is the least uncertainty is to be doubted might have been better and more exactly formulated in the precept that we must consider the degree of assent or dissent which a matter deserves or, more simply, that we must look into the reasons for every doctrine. This would end all the caviling about Cartesian doubt. But perhaps the author preferred to use paradoxes, in order to stimulate the sluggish reader through novelty. I wish, however, that he had remembered his own precept or, rather, that he had understood its true force. We can best explain this matter and its application by the example of geometricians. They are agreed upon axioms and postulates, upon whose truth the rest depends. We accept these, both because they satisfy the mind immediately and because they are proved by countless experiences; nevertheless, it would be an aid to the perfection of science to prove them. This was attempted of old for certain axioms by Apollonius and Proclus and recently by Roberval. Euclid tried to prove that two sides of a triangle taken together are greater than the third (a fact which, as a certain old writer jokingly said, even a jackass knows when he goes to his feed in a straight line rather than a roundabout way), because it was his purpose to base geometric truths not on sensory images but on reason. In the same manner he might also have demonstrated that two straight lines (which do not coincide when extended) can have only one point in common if he had only had a good definition of a straight line.[24] I am convinced that the demonstration of the axioms is of great assistance to true analysis or the art of discovery. So if Descartes had wished to carry out what is best in his rule, he should have worked at the demonstration of scientific principles and thus achieved in philosophy what Proclus tried to do in geometry, where it is less necessary. But our author seems sometimes to have preferred applause rather than certainty. I should not blame him for being satisfied so often with verisimilitude, if he himself had not aroused expectations with so strong a profession of exactness. I blame Euclid much less for assuming certain things without proof, for he at least established the fact that, if we assume a few hypotheses, we can be sure that what follows is equal in certainty, at least, to the hypotheses themselves. If Descartes or other philosophers had done something similar to this, we should not be in difficulty. Moreover, the skeptics, who despise the sciences on the pretext that they sometimes use undemonstrated principles, ought to regard this as said also to them. I hold, in contrast, that the geometricians should be praised because they have pinned down science with such pegs, as it were, and have discovered an art of advancing and of deriving so many things from a few. If they had tried to put off the discovery of theorems and problems until all the axioms and postulates had been proved, we should perhaps have no geometry today.

On Article 2. Furthermore, I do not see what good it does to consider what is doubtful as false. This would be not to lay aside prejudices but to change them. But if this is understood merely as a fiction, it should not have been abused, as, for instance, in the fallacy which will be seen, below in Article 8, to arise where the difference between mind and body is discussed.

On Article 4. About sensible things we can know nothing more, nor ought we to desire to know more, than that they are consistent with each other as well as with rational principles that cannot be doubted, and hence that future events can to some extent be foreseen from past. To seek any other truth or reality than what this contains is vain, and skeptics ought not to demand any other, nor dogmatists promise it.[25]

On Article 5. There can be no doubt in mathematical demonstrations except insofar as we need to guard against error in our arithmetical calculations. For this there is no remedy except to re-examine the calculation frequently or to have it tested by others and also to add confirmatory proofs. This weakness of the human mind arises from a lack of attention and memory and cannot be completely overcome, and Descartes's mention of it, as if he knew a remedy, is in vain. It would be enough if the state of affairs in other fields were the same as that in mathematics; indeed, all reasoning, even the Cartesian, however convincing and accurate, is subject to this doubt, whatever may be said about some powerful deceiving spirit or about the distinction between dreams and waking.

On Article 6. We have a free will not in perceiving but in acting. Whether honey will seem sweet or bitter to me does not lie with my will, but neither does it lie with my will whether a proposed theorem will seem true or false to me; it is the business of consciousness merely to examine what appears to it. Whoever makes an affirmation of anything is conscious either of a present perception or reason or at least of a present memory bringing back a past perception or the perception of a past reason, although we are often deceived in this through unreliable memory or faulty attention. But consciousness of the present or past is in no way dependent on our will. This one thing we recognize to be within the power of will—to command attention and exertion. And so the will, though it does not bring about any opinion in us, can nevertheless contribute to it obliquely. Thus it happens that men often finally come to believe that what they will to be true, after having accustomed the mind to attend most strongly to the things which they favor. In this way they finally succeed in making it satisfy not merely their will but also their consciousness.[26] See on Article 31.

On Article 7. I think, therefore I am. Descartes has well noted that this belongs to the first truths. But it would have been equitable not to neglect others of equal significance. In general, therefore, this can be expressed as follows. Truths are either of fact or of reason. The primary truth of reason is the principle of contradiction or, what amounts to the same thing, that of identity, as Aristotle has rightly observed. There are as many primary truths of fact as there are immediate perceptions or, if I may say so, consciousnesses. However, I am conscious not only of myself thinking but also of my thoughts, and it is no more true and certain that I think than that this or that is thought by me. Hence the primary truths of fact can conveniently be reduced to these two: "I think" and "Various things are thought by me." Whence it follows not only that I am but that I am affected in various ways.

On Article 8. It is not valid to reason: "I can assume or imagine that no corporeal body exists, but I cannot imagine that I do not exist or do not think. Therefore I am not corporeal, nor is thought a modification of the body." I am amazed that so able a man could have based so much on so flimsy a sophism. Certainly he adds nothing more in this article; what he has added to it in the *Meditations* I shall examine in its proper place. No one who thinks that the soul is coporeal will admit that we can assume that nothing corporeal exists, but he will admit that we can doubt (as long as we are ignorant of the nature of the soul) whether anything corporeal exists or does not exist. And since we nevertheless see clearly that our soul exists, he will admit that only one thing follows from this: that we can still doubt that the soul is corporeal. And no amount of torture can extort anything more from this argument. But Descartes provided an opening for this fallacy above in Article [illegible] by taking the license of rejecting what is doubtful as false, so that it becomes possible to assume that there are no corporeal beings because we can doubt that they exist, a point which cannot be granted him. It would be different if we understood the nature of the soul as perfectly as we do its existence, for then it would be established that whatever does not appear in it is not in it.

On Article 13. I have already observed, on Article 5, that the errors which can arise from defective memory or attention and which can also occur in arithmetical calculations even after a perfect method has been found, as in numbers, have been mentioned here to no purpose, since no method can be devised in which such errors are not to be feared, especially when the reasoning is long drawn out. So one must resort to criteria. For the rest, God seems to be called in here merely as a kind of display or showpiece,[27] not to mention that strange fiction or doubt as to whether we are not led to err even in the most evident things, which should convince no one because the nature of evidence prevents it and the experiences and successes of the whole of life witness against it. And if this doubt could once be justly raised, it would be straightway insuperable; it would always confront Descartes himself and anyone else, however evident the assertions presented by them. Aside from this, we must recognize that this doubt cannot be established by denying God or removed by introducing him. For even if there were no God, we should nonetheless be capable of truth, if only it remained possible for us to exist. And, even if it be granted that God exists, it does not thence follow that there exists no created being that is fallible in the extreme and imperfect, especially since it is possible that its imperfection may not be native but superinduced, perhaps by some great sin, as the Christian theologians teach concerning original sin, so that this evil could not be imputed to God. But even though it does not seem appropriate to have introduced God here, I nevertheless think that the true knowledge of God is the principle of higher wisdom, though for other reasons. For God is the first cause no less than the ultimate reason of things, and there is no better knowledge of things than through their causes and reasons.

On Article 14. The argument for the existence of God taken from the concept of God was first discovered and stated, so far as is known, by Anselm, archbishop of Canterbury, in his book Contra insipientem, which still exists.[28] It was frequently examined by various authors of the Scholastic theology and by Thomas Aquinas himself, from whom Descartes, who was no stranger to this knowledge, having studied with the Jesuits of La Fleche, seems to have borrowed it. This reasoning contains something beautiful but is nevertheless imperfect. The argument reduces to this. Whatever can be demonstrated from the concept of a thing can be ascribed to that thing. Now, from the concept of a most perfect or greatest being, its existence can be demonstrated. Therefore existence can be attributed to the most perfect being (God), or God exists. The minor premise is proved thus: The most perfect or greatest being contains all perfections, and therefore existence, which is undoubtedly one of the perfections, since it is more or greater to exist than not to exist. So much for the argument. But, by omitting perfection and greatness, the argument could have been formulated more fittingly and strictly in this way. A necessary being exists (that is, a being whose essence is existence or a being which exists of itself), as is clear from the terms. Now God is such a being, by definition of God. Therefore God exists. These arguments are valid, if only it is granted that a most perfect being or a necessary being is possible and implies no contradiction or, what amounts to the same thing, that an essence is possible from which existence follows. But, as long as this possibility is not demonstrated, the existence of God can by no means be considered as perfectly demonstrated by such an argument. In general, we must recognize, as I have long since pointed out, that nothing can safely be inferred about a definite thing out of any given definition, as long as the definition is not known to express something possible. For if it should happen to imply some hidden contradiction, it would be possible for something absurd to be deduced from it.[29]

Meanwhile we do learn from this argument the admirable advantage of the divine nature, that, if it is merely possible, by this fact itself it exists, an argument which does not suffice to prove the existence of other things. Therefore to have a geometric demonstration of the divine existence it remains only to demonstrate the possibility of God with an exactness adequate for geometric rigor. Meanwhile the existence of a thing which merely needs possibility thus acquires great credibility; and, besides, that there is some necessary thing is established in another way, from the fact that contingent things exist.[30]

On Article 18. That we have an idea of a perfect being and that a cause of that idea therefore exists—that is, a perfect being exists (this is Descartes's second argument)—is more doubtful than the possibility of God and is denied by many of those who profess with the highest zeal not merely the possibility but also the existence of God. Nor is the remark valid which, as I recall, Descartes made somewhere to the effect that, when we speak of something with an understanding of what we say, we have an idea of the thing.[31] For it often happens that we combine things that are incompatible, as when we think of a most rapid motion, which is certainly impossible, and hence not an idea; and yet we may speak of it, understanding what we mean. For I have elsewhere explained that we often think only confusedly of what we are talking about, and we are not conscious of the existence of an idea in our mind unless we understand the thing and analyze it sufficiently.[32]

On Article 20. The third argument suffers, among other things, from the same vice, namely, when it assumes that there is in us an idea of the highest perfection, God, and concludes from this that God exists because we who have this idea exist.

On Article 21. From the fact that we now are, it follows that we will be in the next moment, unless there exists a reason for change. And so, unless it were established in some other way that we cannot even exist without the beneficence of God, nothing is established about the existence of God from our own duration; as if one part of this duration were entirely independent of another, which we cannot admit.[33]

On Article 26. Even though we are finite, we can yet know many things about the infinite: for example, about asymptotic lines, or lines which approach each other continuously when infinitely produced but never meet; about spaces which are infinite in length but not greater in area than a given finite space; and about the sums of infinite series. Otherwise we should also know nothing with certainty about God. However, it is one thing to know something about a matter and another to comprehend the matter, that is, to have within our power all that is hidden in the matter.

On Article 28. As for the ends which God has proposed to himself, I am fully convinced both that they can be known and that it is of the highest value to investigate them; and that to disdain this inquiry is not without danger or suspicion. In general, whenever we see that anything is particularly useful, we may safely assert that one, among others, of the ends which God has proposed to himself in creating this thing is precisely that it render these services, since he both knew and planned this use of it. I have elsewhere pointed out, and shown by examples, that certain concealed physical truths of great importance can be discovered by considering final causes, which could not have been discovered as easily by efficient causes.[34]

On Article 30. Even if we admit that the perfect substance exists and that it is in no way the cause of imperfections, we shall not thereby remove the true or fictitious reasons for doubt which Descartes introduced, as I have already pointed out in Article 13.

On Articles 31, 35. I do not admit that errors are more dependent upon the will than upon the intellect. To give credence to what is true or to what is false—the former being to know, the latter to err—is nothing but the consciousness or memory of certain perceptions or reasons and so does not depend upon will except insofar as we may be brought by some oblique device to the point where we seem to see what we wish to see, even when we are actually ignorant. See Article 6. Hence we make judgments not because we will but because something appears. And when it is said that will reaches further than intellect, this is more ingenious than true; to put it bluntly, it is a bit of popular ornamentation. We will only what appears to the intellect. The source of all errors is precisely the same in its own way as the reason for errors which is observed in arithmetical calculation. For through a lack of attention or memory it often happens that we do what we ought not, or fail to do what we ought, or that we think that we have done what we did not do, or have not done what we have. So it happens in calculations (to which reasoning corresponds in the mind) that necessary figures are not put down but unnecessary ones are, or that something is skipped in the combination, or that the method is not duly observed. For when our mind is tired or distraught, it does not adequately attend to its present operations, or it assumes by an error of memory that something was long since proved which has become more firmly fixed in us only because it was more frequently impressed, or more fixedly considered, or more eagerly desired. The remedy for our errors is the same as that for errors in calculation—to pay attention to the matter and form, to proceed slowly, to repeat and vary our operations, to introduce tests and checks, to divide longer chains of reasoning into parts so that the mind gets a breathing spell, and to confirm each part in turn through special proofs. And since we are sometimes in a hurry to act, it is an important matter to have acquired presence of mind through practice, as do those who are still able, in the midst of noise and without written calculations, to compute very large numbers. Thus the mind will not be easily distracted, whether by the external senses or by its own images and affections, but will rise above what it is doing and retain the power of criticism or, as it is commonly called, of reflecting upon itself, so that it can constantly say to itself, as would an external monitor, "Watch what you are doing. Why are you doing it? Time is passing." The Germans use the excellent term: *sich begreifen*; the French, the equally happy one: s'aviser, as if to warn one's self, to suggest to one's self, as the Roman nomenclators pointed out to Roman candidates the names and merits of influential citizens, or as the prompter gives out cues for the remaining lines to a comedian, or a certain youth called out to Philip of Macedon: "Remember that you are mortal." But this very criticism, this *s'aviser*, is not in our power or choice of our will; it must first of all occur to our intellect, and it depends upon the present degree of our perfection. It is the business of the will to strive beforehand with all zeal, to prepare the mind well in advance. This can be done usefully, partly through a contemplation of the experiences of others, their injuries and dangers; partly by the use of our own experiences, which should if possible be free of danger, or at least involve only slight and negligible harm; and partly also by training the mind to follow a definite series and method when thinking, so that later the required attitude offers itself spontaneously, as it were. However, there are matters which escape us or do not occur to us through no fault of ours; in these we suffer from a defect, not of judgment, but of memory or of mental capacity, and so are not so much in error as in ignorance, since it is beyond our power to know or to remember all that we will. This is not a matter to be discussed here. That sort of critical reflection by which we fight against a lack of attention will suffice. Whenever memory reports to us past proofs which may not have been valid, we should hold the confused recollection for suspect, and either repeat our inquiry if possible and if the matter is important or trust past proofs only if sufficient care has been given them.

On Article 37. The highest perfection of man consists not merely in that he acts freely but still more in that he acts with reason. Better, these are both the same thing, for the less anyone's use of reason is disturbed by the impulsion of the affections, the freer one is.

On Article 39. To ask whether our will is endowed with freedom is the same as to ask whether our will is endowed with will. Free and voluntary signify the same thing. For freedom is the same as spontaneity with reason, and to will is to be brought to act through a reason perceived by the intellect. But the purer this reason is, and the less mixed up it is with the impact of base and confused perceptions, the freer is the act. To refrain from judgment is not the business of our will but of the intellect imposing upon itself some critical reflection, as I have already said on Article 35.

On Article 40. Anyone who is convinced that God preordains all things but that he himself is free, and who is shown the conflict between these views but replies only what Descartes recommends, namely, that his mind is finite and cannot grasp such matters, seems to me to be answering the conclusion rather than the argument and to be cutting rather than untying the knot. The question is not whether we grasp the matter itself but rather whether we grasp our own absurdity when it is pointed out. There should surely be no contradiction even in the mysteries of faith; much less so in the mysteries of nature. So if we wish to stand out as philosophers, we must once more taken up the argument, which with some semblance of truth implies contradictory conclusions from your own assertions, and uncover the fallacy in it, a thing which is certainly always possible unless we have made a mistake.

On Articles 43, 45, 46. I have elsewhere called attention to the fact that there is not much use in the celebrated rule that only what is clear and distinct shall be approved, unless better marks of clearness and distinctness are offered than those of Descartes. Preferable are the rules of Aristotle and the geometricians, namely, that with the exception of principles, that is, of first truths or hypotheses, we are to admit nothing unless proved by a valid argument. By valid, I mean one that is suffering from neither a formal nor a material fallacy. There is a material fallacy when anything is assumed besides principles and what has been further proved from principles by a valid argument. Also, by right form I understand not only the common syllogistic form but also any other form demonstrated beforehand which is conclusive by virtue of its structure. The forms of arithmetical and algebraic operations also meet this requirement, as do the forms of the bookkeepers, and indeed to some extent the forms of judicial processes, for sometimes we are content to act upon a certain degree of probability. However until now the part of logic, of great practical value, which deals with the calculation of degrees of probability, remains to be treated; I myself have set down a number of things about it. On form, compare further what is said on Article 75.

On Articles 47, 48. Someone, I do not know who (Comenius, I believe), rightly pointed out long ago that, though Descartes promises in Article 47 summarily to enumerate all the simple concepts, he deserts us at once in Article 48, and, having named some, he adds "and so forth." Besides, several of those which he names are not simple. This is an inquiry of greater importance than is thought.

On Article 50. It is most desirable to demonstrate truths which are relatively simple but which the prejudiced opinions of men keep them from admitting, by means of simpler ones.

On Article 51. I do not know whether the definition of substance as that which needs for its existence only the concurrence of God fits any created substance known to us, unless we interpret it in some unusual sense. For not only do we need other substances; we need our own accidents even much more. Therefore, since substance and accident depend upon each other, other marks are necessary for distinguishing a substance from an accident. Among them may be this one: that a substance needs some accident but often does not need a determinate one but is content, when this accident is removed, with the substitution of another. An accident, however, needs not only some substance in general but that very one in which it inheres, so that it cannot change it. But there are other things of greater importance and worthy of a profounder discussion, which remain to be said elsewhere about the nature of substance.

On Article 52. I admit that there is one principal attribute of every substance which expresses its essence, but if we mean an individual substance, I doubt whether this can be explained in words and especially in a few words, in the way the other genera of substances may be explained by definitions.[35] That extension constitutes the common nature of corporeal substance I find asserted by many, with much confidence, but never proved. Certainly neither motion or action nor resistance or passion can be derived from it. Nor do the natural laws which are observed in the motion and collision of bodies arise from the concept of extension alone, as I have shown elsewhere. Indeed, the notion of extension is not a primitive one but is resolvable. For an extended being implies the idea of a continuous whole in which there is a plurality of things existing simultaneously. To speak of this more fully, there is required in extension, the notion of which is relative, a something which is extended or continued as whiteness is in milk, and that very thing in a body which constitutes its essence; the repetition of this, whatever it may be, is extension. I fully agree with Huygens, whose opinion in natural and mathematical matters I value highly, that the concept of an empty place and of extension alone is the same. In my judgment mobility or antitypy themselves cannot be understood from extension alone but from the subject of extension, by which place is not merely constituted but filled.

On Article 54. I do not recall that it has ever been perfectly demonstrated either by our author or by his followers that the thinking substance lacks extension or the extended substance lacks thought, so that we can be certain that the one attribute is not demanded for the other in the same subject and, indeed, cannot ever subsist along with it. Nor is this strange, for the author of the Recherche de la vérité (who has made some excellent critical remarks) has rightly pointed out that the Cartesians have given no distinct concept of thought; so it is not strange that they do not exactly know what is involved in it.[36]

On Articles 60, 61. To deny a real distinction between modes is an unnecessary change in the accepted use of words. For until now modes have been considered as things and have been held to differ in reality, as a spherical figure of wax differs from a square one. Certainly the transformation of one figure into the other is a true change, and it has therefore a real foundation.

On Article 63. To conceive of thought and extension as of the thinking or extended substance itself seems to me neither correct nor possible. Such an expedient is suspect and is similar to that which enjoins us to hold the doubtful for false. Such distortions of things prepare minds for stubbornness and fallacies.

On Articles 65—68. Descartes, following the ancients, rendered a useful service in eradicating the prejudice that makes heat, colors, and other phenomena seem to be things outside of us, since it is evident that the same hand on which water seemed very hot soon finds it tepid; and a man who observes a green color in a powdered mixture no longer sees it as green when his eye is aided by an instrument but as a mixture of yellow and blue and can grasp the causes of these two colors with the use of better instruments and other observations or reasons. From these considerations it seems that no such thing exists outside of us, the phantasm of which appears to our imagination. We are commonly like boys who have been convinced that there is a pot of gold at the very end of the rainbow where it touches the earth and who run toward it in a vain effort to find it.[37]

On Articles 71—74. In my comments on Articles 31 and 35, I have already made some remarks about the causes of error. These also provide reasons for the errors discussed here, for the prejudices of infancy belong to the class of unproved assumptions. Moreover, fatigue diminishes attention, and the ambiguity of words belongs with the abuse of signs and involves a formal fallacy. This is as if we put X in place of V in our calculation, to use a German proverb, or as if a druggist were to put sandarac into his prescription in place of dragon's blood [sanguis draconis].

On Article 75. It seems to me only fair to give the ancients their due and not to conceal their merits by a silence that is malignant and injurious to ourselves. The things which Aristotle set down in his logic, though not sufficient for discovering, are nonetheless generally sufficient for judging, at least where necessary consequences are concerned. It is an important thing for the conclusions of the human mind to be stablized as if by certain mathematical rules. And I have pointed out that the fallacies which are introduced into serious matters are more often sins against logical form than is commonly believed. So, to avoid all errors, nothing more is necessary than to make use of the most common rules of logic with great constancy and rigor. But, because the complexity of matters often prevents this persistence, we provide certain special logical forms in the sciences and in fields of action, which should be demonstrated in advance by these general rules but with the peculiar nature of the subject taken into consideration. Just so Euclid has a certain logic of his own concerning the conversion, composition, and division of proportions, which are first proved in a particular book of the Elements and then are applied throughout the whole geometry.[38] Thus both brevity and confidence are assured, and the more of rules of this kind we have the more we improve science. Add to this what I have observed on Articles 43 ff. on so-called "formal argumentations" which should be more widely extended than is commonly believed.

On Part II

On Article 1. The argument by which Descartes tries to prove that material things exist is weak; it would have been better not to try. The gist of the argument is this: the reason why we perceive material things lies outside of us; therefore it is either in God or in someone else or in the material things themselves. It is not in God, for, if no material things existed, he would be a deceiver; it is not in someone else—this he has forgotten to prove; therefore it is in the things themselves, and they therefore exist. To this we can reply that a sensation may come from some other being than God, who permits other evils for certain important reasons and who can also permit us to be deceived without having himself the character of a deceiver, especially since this involves no injury, since it would rather be disadvantageous for us to be undeceived. Besides, there is a further fallacy in that the argument neglects another possibility -- that, while our sensations may indeed be from God or from someone else, the judgment (as to whether the cause of the sensation lies in a real object outside of us), and hence the deception itself, may originate in us. A similar thing happens when colors and other things of this sort are held to be real objects. Through previous sins, moreover, souls may have deserved their condemnation to such a life full of deception, in which they snatch at shadows instead of things. The Platonists do not seem to have shrunk back from such an opinion, since this life seemed to them like a dream in the cave of Morpheus, the mind having lost its reason through the lethal drink before it came here, as the poets used to say.[39]

On Article 4. Descartes tries to prove that body consists in extension alone by enumerating the other attributes and eliminating them. But he should have shown that his enumeration is complete. Also, not all the attributes are correctly eliminated; in fact, those who hold to atoms, that is, to bodies of maximum hardness, will hold, not that hardness consists in a body not yielding to the pressure of the hands, but in it conserving its shape. And those who find the essence of body in antitypy or impenetrability derive the concept of it, not from our hands or from any senses, but from the fact that a body does not give place to another body homogeneous to it unless it can move elsewhere. Thus if we imagine a cube having six other cubes exactly similar to it converging upon it simultaneously and with equal velocities, so that a face of each one of them exactly coincides with one face of the confined cube, then it will be impossible for either the confined cube or any part of it to be moved from its position, whether it be thought of as flexible or rigid. But if this middle cube be thought of as penetrable extension or mere space, then the six concurrent cubes will oppose one another with their edges; but, if they are flexible, nothing will prevent their middle parts from breaking into the confined cubical space. From this we may also understand what the difference is between hardness, which is a property of some bodies only, and impenetrability, which belongs to all. Descartes should have considered the latter as well as hardness.

On Articles 5, 6, and 7. Descartes has admirably explained that the rarefaction and condensation which we perceive by sense can occur without our having to admit either the existence of vacua interspersed within matter or a change of dimensions in the same part of matter.

On Articles 8—19. Many of those who defend a vacuum hold space to be a substance and hence cannot be refuted by Descartes's arguments. Other principles are needed to end this dispute. They will admit that quantity and number have no being outside the things to which they are attributed, but they will deny that space or place is the quantity of a body; they will assume rather that space has a quantity or capacity equal to that of the body contained in this space. Descartes should have shown that the space or internal place of a body is not different from its substance.[40] Those who hold the contrary will defend their view with the popular conception of mortals, according to which one body, in succeeding another, passes into the same place and the same space which the former body has deserted—a thing which cannot possibly be said if space coincides with the very substance of the body. Though it may be accidental to a body, however, to have a certain position or to be in a given place, these opponents will no more admit that place is itself an accident of the body than they will that, since contact is an accident, the body contacted is also one. Indeed, it seems to me that Descartes does not so much offer sound reasons for his own opinions as he replies to opposing arguments, which he does very skilfully at this point. And he often uses this device instead of demonstration. But we expected something more, and, if I am not mistaken, we were invited to expect it. It must be admitted that nothingness has no extension, and this is a fit retort to all who assume some imaginary—I know not what—sort of space. But those who consider space a substance are not touched by this argument; they would certainly be affected if Descartes had proved above what he assumes here, namely, that every extended substance is a body.[41]

On Article 20. The author's attack on atoms does not seem to be satisfactory. Those who defend them will admit that they can be divided in our thinking as well as by divine power. But the question which (to my amazement) Descartes does not even touch on here is whether bodies which have a firmness which natural forces cannot overcome (this is, according to them, the true concept of atoms) can exist naturally at all. Yet he declares here that he has destroyed the atoms and assumes it in the whole further course of his work. We shall say more about atoms below, on Article 54.[42]

On Articles 21, 22, and 23. That the world has no limits in extension and hence can be only one and that the whole of matter is everywhere homogeneous and therefore can be differentiated only through its motions and shapes—these are opinions which are here built upon the proposition that the extended and body are the same, though this is neither universally admitted nor demonstrated by the author.[43]

On Article 25. If motion is nothing but the change of contact or of immediate vicinity, it follows that we can never define which thing is moved. For just as the same phenomena may be interpreted by different hypotheses in astronomy, so it will always be possible to attribute the real motion to either one or the other of the two bodies which change their mutual vicinity or position. Hence, since one of them is arbitrarily chosen to be at rest or moving at a given rate in a given line, we may define geometrically what motion or rest is to be ascribed to the others, so as to produce the given phenomena. Hence if there is nothing more in motion than this reciprocal change, it follows that there is no reason in nature to ascribe motion to one thing rather than to others. The consequence of this will be that there is no real motion. Thus, in order to say that something is moving, we will require not only that it change its position with respect to other things but also that there be within itself a cause of change, a force, an action.[44]

On Article 26. From what has been said in the preceding paragraph it follows that Descartes's assertion that no more action is required in a body for motion than for rest cannot be sustained. I admit that force is necessary for a body at rest to maintain its rest against colliding bodies. But this force is not in the body itself which is at rest, for the surrounding bodies themselves, opposing each other by their force of motion, cause the body at rest to preserve its given position.[45]

On Article 32. Archimedes was the first author transmitted to us who worked on the composition of motion, in his treatise on spirals. Kepler, in his Optical paralimpomena, was the first to apply this to an explanation of the equality of the angles of incidence and reflection, by dividing an oblique motion into a perpendicular and a parallel motion. In this Descartes followed him, as he did also in his Dioptrics. Galileo was the first to show the fullest use of the composition of motion in physics and mechanics.[46]

On Articles 33, 34, 35. What Descartes says here is most beautiful and worthy of his genius, namely, that every motion in filled space involves circulation and that matter must somewhere be actually divided into parts smaller than any given quantity. Yet he does not seem to have weighed sufficiently the importance of this last conclusion.

On Article 36. The most famous proposition of the Cartesians is that the same quantity of motion is conserved in things. They have given no demonstration of this, however, for no one can fail to see the weakness of their argument derived from the constancy of God. For although the constancy of God may be supreme, and he may change nothing except in accordance with the laws of the series already laid down, we must still ask what it is, after all, that he has decreed should be conserved in the series—whether the quantity of motion or something different, such as the quantity of force. I have proved that it is rather this latter which is conserved, that this is distinct from the quantity of motion, and that it often happens that the quantity of motion changes while the quantity of force remains permanent. The arguments by which I have shown this and defended it against objections may be read elsewhere.[47] But, since the matter is of great importance, I shall give the heart of my conception in a brief example. Assume two bodies: A with a mass of 4 and a velocity of 1, and B with a mass of 1 and a velocity of 0, that is, at rest. Now imagine that the entire force of A is transferred to B, that is, that A is reduced to rest and B alone moves in its place. We ask what velocity B must assume. According to the Cartesians, the answer is that B should have a velocity of 4, since the original quantity of motion and the present quantity would then be equal, since mass 4 multiplied by velocity 1 is equal to mass 1 multiplied by velocity 4. Thus the increase in velocity is proportional to the decrease of the quantity of the body. But in my opinion the answer should be that B, whose mass is 1, will receive the velocity 2, in order to have only as much quantity of power as A, whose mass is 4 and whose velocity is 1. I shall explain my reason for this as briefly as possible, lest I appear to have proposed it without any reason. I say, then, that B will have only as much force as A had previously or that the present and the former force are equal, a thing which is worth proving. To go deeper, namely, and explain the true method of computation—which is the duty of any really universal mathematics, though it has not yet been carried out—it is clear, first of all, that force is doubled, tripled, or quadrupled when its simple quantity is repeated twice, three times, or four times, respectively. So two bodies of equal mass and velocity will have twice as much force as one of them. It does not follow, however, that one body with twice the velocity must have only twice the force of a body with simple velocity, for even though the degree of velocity may be doubled, the subject of this velocity is not itself duplicated, as it is when a body twice as great, or two bodies of the same velocity, are taken in place of one, so that they completely repeat the one in magnitude as well as motion. Similarly 2 pounds elevated to the height of 1 foot are exactly double in essence and power to one elevated the same distance, and two elastic bodies stretched equally are double one of them. But when the two bodies possessing this power are not fully homogeneous and cannot be compared with each other in this way, or reduced to a common measure of matter and force, an indirect comparison must be attempted by comparing their homogeneous effects or causes. Every cause whatever has a force equal to its total effect, or to the effect which it produces in using up its own force. Therefore, since the two bodies mentioned above, *A* with mass 4 and velocity 1, and *B* with mass 1 and velocity 2, are not exactly comparable, and no one quantity possessing force can be designated whose simple repetition will produce both, we must examine their effects. Let us assume, namely, that these two bodies are heavy and that *A* can change its direction and rise; then by virtue of its velocity of 1 it will rise to the height of 1 foot, while *B*, by virtue of its velocity of 2, will rise 4 feet, as Galileo and others have demonstrated. In each case the effect will entirely consume the force and so be equal to the cause which produces it. But these two effects are equal to each other in force or power, namely, the elevation of body *A*, 4 pounds, to 1 foot, and the elevation of body *B*, 1 pound, to 4 feet. Therefore the causes, too, are equal; that is, the body *A* of 4 pounds with velocity of 1 is equal in force or power to the body *B* of 1 pound with velocity 4, as was asserted. But if someone denies that the same power is needed to raise 4 pounds 1 foot and 1 pound 4 feet, or that these two effects are equivalent (though, unless I am mistaken, almost everyone will admit this), he can be convinced by the same principle. If we take a balance with unequal arms, 4 pounds can be raised exactly 1 foot by the descent of 1 pound for 4 feet, and no further work can be done; thus the effect exactly exhausts the power of the cause and is equal to it in force. Let me summarize, therefore. If the whole power of body *A*, 4, with a velocity of 1, is transferred to *B*, 1, *B* must receive a velocity of 2; or, what amounts to the same thing, if *B* is first at rest and *A* in motion, but *A* is then at rest and *B* has been placed in motion, other things remaining equal, the velocity of *B* must be double, since the mass of *A* was quadruple. If, as is popularly held, *B* should receive four times the velocity of *A* because it has one-fourth of its mass, we should have perpetual motion or an effect more powerful than its cause. For, when *A* was moving, it could raise 4 pounds only 1 foot, or 1 pound 4 feet; but later, when *B* moved, it would be able to lift 1 pound 16 feet, for altitudes are as the square of the velocities by force of which bodies are lifted, and four times the velocity will raise a body sixteen times the altitude. With the aid of *B* not only could we thus once more raise *A* for 1 foot, after its descent had given it its original velocity, but we could do many other things besides and thus exhibit perpetual motion, since the original force is restored but there is still more left. Moreover, even though the assumption that the whole force of *A* is transmitted to *B* cannot actually be realized, this does not affect the matter, since we are here concerned with the true calculation, or with the question of how much force *B* would necessarily take on according to this hypothesis. Even if a part of the force is retained and only a part transmitted, the same absurdities would still arise, for, if the quantity of motion is to be conserved, the quantity of forces can obviously not always be conserved, since the quantity of motion is known to be the product of mass and velocity, while the quantity of force is, as we have shown, the product of mass and the altitude to which it can be raised by force of its power, altitudes being proportional to the square of the velocities of ascent. Meanwhile this rule can be set up: The same quantity of force as well as of motion is conserved when bodies tend in the same directions both before and after their collision, as well as when the colliding bodies are equal.[48]

On Articles 37, 38. It is a very true and indubitable law of nature that the same thing, so far as in it lies, always persists in the same state—a law which both Galileo and Gassendi, and several others as well, have long held. It is surprising therefore that it has occurred to some men that a projectile owes the continuation of its motion to the air but that it has not occurred to them that by this same reasoning we should with equal right have to look for some new reason for the continued motion of the air itself. For air could not, as they hold, impel the stone forward unless it itself had the power to continue its received motion and found itself impeded in this by the resistance of the stone.

On Article 39. Not only did Kepler observe the very beautiful law of nature according to which bodies describing a circular or curved path strive to leave it in the line of the tangent straight line (others may have preceded him in this), but he already made that application of this law which I consider essential in making clear the cause of gravity. This is apparent from his Epitome of the Copernican Astronomy.[49] Descartes has rightly affirmed this law and brilliantly expounded it, but he has not demonstrated it, as one would have expected of him.

On Articles 40-44. In Articles 37 and 39 Descartes has presented two very true laws of nature which are clear in their own light. But the third seems to me to be so far, not merely from truth, but even from probability, that I wonder how it ever occurred to the mind of such a man. Yet he at once builds his laws of motion and of impact upon it and says that it contains all the causes of particular changes in bodies. He conceives it as follows: one body colliding with another stronger one loses none of its motion but merely changes its direction; however, it can receive some additional motion from the stronger body. But, in colliding with a weaker body, it loses only as much motion as it transfers to the weaker body. In actual fact, however, it is only in the case of a collision of bodies moving in opposite directions that a body colliding with a stronger one loses no motion but either retains or increases its velocity. When a weaker but swifter body overtakes one that is stronger but slower, then the contrary occurs, and it is generally true, and can be observed in nature, that the velocity of the pursuing body is diminished by the impact. For, if it continued its motion after the collision, it could not in any case proceed at its earlier velocity without giving this velocity to the body ahead as well, in which case the total power in the whole would be increased. If it came to rest after the collision, it would be clear in itself that its velocity had been diminished, and indeed destroyed, by the blow. This coming to rest, moreover, occurs in hard[50] bodies (which are here always to be understood) when the ratio of the excess of mass in the first body over that of the one overtaking it to the mass of the body overtaken[51] is double the ratio of the velocity of the first body to the one overtaking it.[52] Finally, if the body is thrown back after the collision, it is again clear that the motion of the repelled body is less than before. For otherwise the velocity of the forward body would necessarily be increased by the added impulsion of the body overtaking it, and, whether we think of it as increasing its velocity after its rebound or merely retaining its earlier velocity, the aggregate of power would be increased, which is absurd.

If anyone were to defend Descartes by holding that this third law of his on the collision of bodies must be understood to deal only with the collision of bodies from opposite directions, I readily agree with it. But then it must be admitted that he has not provided for the collision of bodies moving in the same direction, though, as we have already seen, he himself claims that this law covers all particular cases. Also, if the demonstration which he attempts in Article 41 is correct, it includes all cases of colliding bodies, whether they move in the same or in opposite directions. But it does not seem to me to have even the semblance of a proof. I admit that it is correct to distinguish quantity and direction of motion and that one of these sometimes changes while the other remains constant. But it is also true that frequently both change together. In fact, both work together to preserve each other, and a body tends to preserve its determination or direction with its whole force and its whole quantity of motion. Whatever is taken away from the velocity when the direction remains constant is also lost from the determination, since a body proceeding more slowly in the same direction is less determined to conserve it. Besides, if a body A collides with a smaller body B at rest, it will continue in the same direction but with diminished motion; if it collides with a body B, at rest but equal to itself, it stops, so that, while it itself remains completely at rest, its motion is transferred to B; and, finally, if it collides with B, which is at rest but greater than it, or is equal to it with an opposite movement, then A will simply be turned back.[53] Hence we can understand that a greater opposing force is necessary for A to be reflected in a direction opposite its original direction than for it merely to be brought to rest, a fact which directly contradicts Descartes's pronouncements. For the opposition must be greater, since the thing opposed is greater, or since the tendency opposing it is greater. But I hold his proposition that motion perseveres as a simple state until it is destroyed by an external cause, to be true not only for the quantity of motion but for its determination also. This determination of a moving body, or its tendency to advance, itself has its own quantity which is more easily diminished than reduced to nothing or to rest and can furthermore be more easily destroyed or reduced to rest than changed into a contrary or regressive motion, as we have just pointed out. Thus, even though one motion is not opposed to another in kind, the present motion opposes the present motion of a body which collides with it, and one advance opposes another contrary advance, since a smaller change and a smaller opposition are necessary, as we have shown, to diminish an advance than to destroy it entirely or to transform it into a retreat. So it seems to me that Descartes's reasoning is like trying to argue that, when two bodies oppose each other, they ought never to break or fall apart but to bend each other so that their shapes are molded to each other, on the ground that matter is distinct from shape and that in this case matter is not opposed to matter, but shape to shape, and the quantity of matter can be conserved in the body while its shape is changed. Whence it would follow that the magnitude of a body can never change and that only the shape of the body can change. If Descartes had taken into consideration that every body which collides with another must, before it is repelled, first reduce its advance, then come to a stop, and only then be turned back, and must thus pass from one direction to the opposite, not by a leap but by degrees, he would have set up other rules of motion for us. We must recognize that, no matter how hard, every body is nevertheless flexible and elastic to some degree; like a ball inflated with air which gives way a little when it falls to the floor or is struck with a stone, until the impetus or advance of what strikes it is gradually broken and at last completely stopped, after which the ball resumes its shape and repels the stone, which now no longer resists, or until it rebounds by itself from the floor to which it had fallen. Experiments have taught us convincingly that something similar to this takes place in every rebound, even if the bending and restoration are not visible. But, being too confident of posterity, Descartes in his letters very superciliously condemned this explanation of reflection by elastic force, which was first noted by Hobbes.[54] We do not need to examine anew the reasoning by which he tries, in Article 42, to demonstrate the last part of this law of nature which he wants to promulgate—the part, namely, which holds that whatever quantity of motion is lost to one colliding body is added to the other. For this assumes that the quantity of motion must remain constant, and we have already shown in Article 36 how great an error this is.

On Article 45. Before I turn to an examination of the special rules of motion given by the author, I shall set up a general criterion or touchstone, as it were, by which they can be examined. I usually call this the law of continuity. I have already explained this principle elsewhere, but it must be repeated and amplified here.[55] When two hypothetical conditions or two different data continuously approach each other until the one at last passes into the other, then the results sought for must also approach each other continuously until one at last passes over into the other, and vice versa. For example, if one focus of an ellipse remains fixed and the other recedes farther and farther away from it, while the latus rectum remains constant, the new ellipses which thus come into being continuously approach a parabola and finally pass over into it completely, namely, when the distance of the receding focus becomes immense. Therefore the properties of these ellipses must also approach more and more the properties of a parabola until at last they pass over into them, and the parabola can be considered as an ellipse whose second focus is infinitely distant. All the properties of an ellipse in general will thus be found in the parabola considered as such an ellipse. Geometry is full of examples of this kind, but nature, whose most wise Author uses the most perfect geometry, observes the same rule; otherwise it could not follow any orderly progress. Thus gradually decreasing motion finally disappears in rest, and gradually diminishing inequality passes into exact equality, so that rest can be considered as infinitely small motion or as infinite slowness, and equality as infinitely small inequality. Whatever is demonstrated about motion in general, or about inequality in general, must for this reason also be verifiable about rest or equality, if this interpretation is right. So the rules for rest or equality can in a sense be considered as special cases of the rules for motion or inequality. If this cannot be done, we may be certain that the proposed rules are inconsistent or wrongly conceived. Hence we shall also show, in Article 53, that to the continuous curve which represents the variations of the hypothetical conditions there must correspond a continuous curve representing the variations of the results but that the Cartesian rules of motion present these results by a figure which is absurd and incoherent.

On Article 46. Let us now examine the Cartesian rules of motion. We must understand the bodies involved to be hard and unimpeded by other conditions.

> Rule 1. If two equal bodies *B* and *C*, with equal velocities, collide directly, both will be deflected with the velocities of their approach.

This first rule is the only one of Descartes that is entirely true. It can be demonstrated in this way: since the properties of both bodies are equal, either both will continue in their motion and so penetrate each other, which is absurd; or both will come to rest, in which case power will be lost; or both will be repelled, and with their original velocity, because, if the velocity of one is diminished, the velocity of the other must also be diminished, because of the equality of their properties. But, if the velocity of both is diminished, the whole will be diminished, which is impossible.

> On Article 47. Rule 2. If *B* and *C* collide with equal velocities, but *B* is the greater, then only *C* is deflected, and *B* continues; both with their earlier velocities, and so both moving in the original direction of *B*.

This rule is false and conflicts with the preceding one, as is clear from the criterion we have just set up. For if the inequality, or the excess of *B* over *A*, is gradually diminished until it passes into full equality, the effects of inequality should also pass over continuously into the effects of equality. So if we assume that *B*, striking *C*, overcomes it with so excessive a force that it continues to advance after the collision, it will be necessary, if *B* is gradually diminished, for its advance also to diminish continuously until, when a certain ratio is reached between *B* and *C*, *B* will at length come to rest and then, by a continuous diminution, be turned into contrary motion; this will gradually increase until finally, when all inequality between *B* and *C* is removed, the motions end in the rule for equality, in which the regressive motion of each body after collision is equal to its progressive motion before collision, as the first rule states.

So this second rule of Descartes cannot stand, for however much we diminish *B* so that it approaches the magnitude of *C*, even to the point at which the difference between the two becomes inexplicably small, the consequences which correspond to these two cases of inequality and equality will still remain very great, if we may believe him, and will not gradually approach each other, since *B* will always continue in the same direction at the same velocity, no matter how small the difference between it and *C* may become. The result is that this irregularity must finally be corrected all at once, so to speak, and a great gap must be introduced in the results to correspond with a very small change in the conditions. At the point, that is, where the excess of *B* over *C* finally disappears completely, and the very small difference between them is further decreased, the motion must pass over from a definite progression to a definite regression, with all the intervening degrees omitted in a single leap, as it were. The result will be that two instances which have an infinitely small variation in the hypotheses or given conditions (that is, a difference smaller than any given amount) will nevertheless have the greatest and most noticeable difference in their results, so that it must be in the very last moment only that the two bodies both begin and end their mutual approach and that they both approach each other and break apart in the moment that they coincide, which is absurd. It would follow that the rule for equal bodies or for bodies with infinitely small inequality could not be subsumed under the general rule for inequality. So since two bodies *B* and *C*, equal and with equal velocities, are both reflected with their previous velocity when they collide with each other (by Rule 1), it follows necessarily that in the case when *B* is somewhat increased or, *B* remaining constant, *C* is diminished, some change must occur in the consequences and something must be added to the result which would still be present when *C* is diminished as much as possible, that is, removed entirely. But when *C* is decreased and becomes less than *B*, we can move from the case of complete equality, or of the total reflection of *B*, to the case of the greatest inequality, or the complete removal of *C* and the unimpeded progress of *B*, only by gradually diminishing the reflection of *B* itself. Then as we gradually increase the difference between *B* and *C*, there will be a point at which *B* will not be reflected at all but will be caught halfway between regression and advance, as it were. If the difference is further increased, *B* will continue to advance in its former direction, though its magnitude can never be increased continuously to such a point that its velocity of advance will not be retarded by collision with a body moving in the opposite direction, until its ratio to *C* becomes infinite, that is, until *C* completely disappears or is removed. This is the true manner of motion of bodies which are unequal but collide with equal velocities; it is in every respect consistent with reason and with itself. This is not the place, however, to determine the quantity of the resulting velocities; that is a matter needing further examination, to which I have given special treatment elsewhere.

> On Article 48. *Rule 3.* If *B* and *C* are equal and collide with unequal and opposite motions, then the more rapid body *B* carries with itself the slower body *C*, and half of the difference of their velocities subtracted from the velocity of *B* is added to the velocity of *C*, so that they move together with equal velocities.

This rule is no less false than the preceding one and conflicts with reason no less than with experience. For to apply our criterion, let the more rapid body *B* carry the slower one with it in the way described, by hypothesis, and let the velocity of *B* decrease continuously until the two become equal or, what amounts to the same thing, until the excess of *B*'s velocity over *C*'s becomes incomparably small. Then both are carried along at the velocity of *B* itself, diminished by no assignable quantity. But this is absurd and contrary to the first rule, which asserts, correctly, that in the case of perfect equality, both of magnitude and of velocity, both are reflected at their own velocity or at least at velocities differing from them by no assignable quantity. And it is impossible for the result of a disappearing inequality not to vanish into the result of equality.

On Article 49. Rule 4. If B is less than C, and B moves while C is at rest, B will be reflected with the velocity of its approach, but C will remain at rest.

This rule is true to this extent—that a smaller body is always deflected by a greater one at rest, though not with the velocity of its approach. For, the more the excess of C[56] is decreased, the more the repulsion is decreased, until we reach the case of equality dealt with in Rule 6. It is absurd for the given conditions gradually to approach the case of the equality of the two bodies while the results do not approach this case but remain constant until at last they pass over into the case of equal bodies at one blow, as it were, or by a leap. One can easily understand, too, that it is far from reasonable for the given conditions to vary continuously while the results vary not at all, since the result ought rather to vary in all things in the same way as do the conditions, except in determinate cases where several distinct variables compensate for each other.

On Article 50. Rule 5. If B is greater than C, and B moves but C remains at rest, then B continues, and both are carried along at the same velocity and with the previous quantity of motion.

This rule too is erroneous, for it errs in fixing the true quantity of the velocity of each body, since it assumes that both advance together after the collision; but this can never happen in the collision of hard bodies. The rule is right in asserting that every larger body which strikes one at rest continues after the collision. But that the two bodies cannot move together in this case is also clear from our criterion. For the case in which B is very little larger than C, and the case in which C is very little larger than B, can be considered to approach each other by an incomparably small difference. So it is impossible that their results should differ so greatly that in the former case they should move together in the direction of B, but in the latter case B should be repelled in the contrary direction with its whole velocity.

On Article 51. Rule 6. If B and C are equal but B moves and *C* remains at rest, then *B* is reflected at three-fourths of its velocity of approach, and *C* will move in the former direction of *B* at the remaining one-fourth of the velocity.

Thus our author; I am not sure that anything more foreign to reason could have been thought up in this matter. It is beyond understanding how such a thing could have occurred to the mind of this distinguished man. But we shall let the Cartesians look for the reason for their master's remarks; it will suffice for us to show the inconsistency of his rules. If *B* and *C* are equal and collide with equal velocities, then both are reflected at the velocity of their approach, by Rule 1. Now if the velocity of *C* be diminished continuously, while that of *B* remains constant, *B* will have to be reflected less and *C* more than before, since the quantity taken from the velocity of one equal body is added to the other. Now let the velocity of *C* disappear, or let it come to rest; we ask how much velocity is to be subtracted from the deflected *B*. This rule of Descartes affirms that only a fourth is to be subtracted. But let us continue by diminishing the magnitude of *C* at rest a little; then, by the preceding rule, *B* will continue its motion. Through a very small change in the conditions, therefore, there results a huge change in the consequences, or a leap occurs. For when *C* is at rest and equal to *B*, the velocity of reflection of *B* is great, namely, three-fourths of its original velocity, but when *C* is diminished a very little, the reflection of *B* is suddenly destroyed entirely; indeed, it is further converted into its contrary, that is, into advance. All the intervening cases are passed over in a leap, which is absurd. We must therefore say that when *B* and *C* are equal and *C* is at rest prior to collision, *B* is at rest after the collision, and its entire velocity is transferred to *C*. This can also be inferred from what is true in Rules 4 and 5. For, by Rule 4, *B* is reflected when it collides with a greater body *C*, which is at rest. Further, by Rule 5, *B* continues in its course when it collides with a smaller body *C*, which is at rest. Therefore when *B* collides with a body *C* at rest which is equal to itself, it neither continues nor is reflected but (what is between these two) comes to rest, and its whole force is transferred to C.

On Article 52. Rule 7. If B and C move in the same direction, with B in the rear moving the more rapidly, and C ahead but more slowly, and C is the greater, but the ratio of C to B is less than the ratio of the velocity of B to that of C, then both will advance together in their earlier direction after collision and with a velocity which will make the quantity of motion the same as it was before collision. But if C remains the greater, but the ratio of C to B is greater than that of the velocity of B to that of C, B will be reflected with its velocity of approach, and C will continue with its former velocity.

Thus our author. But it is easily seen that these rules are inconsistent, for we have observed, not far back, that rigid bodies such as are assumed here never proceed together after collision, as is held to occur in the earlier part of this rule. Nothing is more unreasonable than what is claimed in the latter part—that the body B, in acting on C, changes nothing in C and yet itself suffers many things from the collision. If I am not mistaken, these views conflict with the natural metaphysics (if I may call it so) which the light of reason gives us. There are also other contradictions with earlier rules, for when C is greater by an infinitely small amount, that is, when it is equal to B, and precedes it by an infinitely small velocity, that is, when it remains at rest, the former part of this seventh rule applies, which holds that they would move together; yet, according to the sixth rule, B is reduced to rest and its whole force is transferred to C, which was formerly at rest and equal to it. In the interest of brevity I shall pass over other points no less inconsistent. But I must warn, finally, that the author has disregarded the intermediate case when the ratio of the two bodies is the reciprocal of the ratio of their velocities, and it is not clear what should be said by virtue of his rule in this case. There must indeed be some consequence in this middle case, which should certainly fall within the limits of one or the other earlier case. But, though the former and latter cases have a common limit in terms of the hypotheses, they have none in terms of the consequences, and this again conflicts with our criterion. The case in which B is greater than C is also disregarded. Rule 8 should then have followed, in which the author should have explained what happens when two unequal bodies with unequal velocities moving in opposite directions collide. A distinction would also have to be made between centric and eccentric collisions and between perpendicular and oblique collisions. But we must put an end to this investigation and no longer expatiate upon this discredited and deplorable doctrine.

On Article 53. Descartes acknowledges that it is difficult to use his rules, because, namely, he sees that they completely conflict with experience. But in the true rules of motion there is a remarkable agreement between reason and experience, nor do discrepancies impede the success of the true rules as much as he seems to fear, since he had exceptions already prepared to escape these discrepancies. The greater bodies are in hardness and size, on the contrary, the more accurately the rules are supported by observation. We shall see shortly what the hardness or liquidity of bodies involves; here it seems desirable to show by means of a figure, for easier comprehension, how, by means of our criterion, the truth in these matters can be outlined in advance, as it were, or as a kind of prelude, even before we have succeeded in a perfect delineation of it. This is most useful, both in detecting errors and in approximating the truth.[57]

Let us assume, therefore, that B and C are equal in mass, and let the velocity and direction of B be represented by the straight line BW, so that it moves from B to W with a velocity proportional to BW. Let the velocity and direction of C, which will vary for different cases, be AH, so that in the case of AH_1 or AH_2 (below A) the direction of C will be the same as that of B, and in the case of AH_1 (which is equal to BW) the velocities of both are equal and their directions the same. But when H is taken nearer to A, as in H_2, the direction of C from A to H_2 will still be the same as that of B (from B to W), but its true velocity will be less than that of

B, because AH_2 is less than BW; so, if C precedes, it will be struck by B following it. When H coincides with A (or H_3), the direction and velocity of C are nothing, and C is at rest. But when H is taken above A, as in H_4, H_5, and H_6, the direction of C is contrary to that of B. Now let the lines PP and QQ be drawn so that HP is always the velocity and direction of B, and HQ the direction and velocity of C, after the collision, observing that the direction of either one after the blow, which is the same as that of B before the blow, is represented toward the left, and a resulting direction contrary to this is represented toward the right. Now let us determine a certain point on the lines PP and QQ. The direction and velocity or, in a word, the motion of B before collision, are always BW; now if the motion of C before collision is equal to it and in the same direction, namely, AH_1 (which equals BW), then if no contact hinders, it is certainly true that both B and C will retain their earlier velocities and directions. So the straight lines H_1P_1 and H_1Q_1 representing the motion of B and C after collision will be equal to AH_1 and BW and to the left. But if the motion of C before collision is nothing, or AH_3 (the point H_3 falling on A), or if C is at rest, then what happens is also clear; namely, the body B will be at rest after collision, and the point P_3 will also fall on A, but C will take on the velocity and direction which B had; therefore, H_3Q_3 will be equal to BW and to the left, so that the points P_3 and Q_3 will be occupied. Finally, if the motion of C is equal to the motion of B but in a contrary direction, or is represented by AH_5, equal to BW but with H_5 taken above A (that is, if the two bodies, equal by hypothesis, are assumed to strike with equal velocities from opposite directions), then the outcome is also clear, for each will be reflected with the velocity of its approach, so that the points P_5 and Q_5 will be given; H_5P_5 will be equal to BW but to the right, since B is reflected or moved in a direction contrary to its original one, and H_5Q_5 will be equal to the same thing but to the left, because C assumes the direction which B had taken. So we have as many points P_1, P_3, P_5, falling in a straight line (this is noteworthy) as there are points Q_1, Q_3, Q_5, falling in another straight line parallel to the line AH: the remaining points, such as P_2, P_4, P_6, etc., and Q_2, Q_4, Q_6, etc., cannot be determined by our criterion alone, of course, or from the law of continuity, for these alone do not establish what the lines PP and QQ will be. It is enough that all of them are connected in one continuous line which is their locus by our criterion. Thus all these incoherent rules are already excluded in advance of a full understanding of the matter or of the discovery of the kind of line involved. Meanwhile we actually know, from another source, that the lines PP and QQ are truly straight and that, because of the permutation of velocity and direction in equal bodies, HP is always equal to AH, and HQ to LM, so that HQ as well as LM can be thought of as signifying motion together in the same direction. For the rest, I do not extend H_1, P_1, and Q_1 further down, because then B moves more slowly than C and so does not reach it, and no collision occurs. In the case in which bodies are assumed to have equal velocities, but one body is kept constant in magnitude while the other varies, a figure can be made in the same way to show the consequences of collision upon both bodies in two lines; indeed, a similar figure can be sketched for any hypothesis whatever, providing that the terms are kept constant except for one variable. But it will suffice to have given a sample for one case, especially since everything which we have merely outlined can be understood perfectly by another method--though we can show that this procedure nonetheless has its use in refuting errors. Even if the entire doctrine were not yet discovered, this would lead to a kind of outline of it. From the Cartesian rules no continuous line whatever can be derived for the results which correspond to the continuous line representing the variable data; on the contrary, a figure is produced which is most erratic and contrary to our criterion in Article 45, or to the *law of continuity.* If our line is compared with the Cartesian one in the figure, the inconsistency, or rather the impossibility, of his rules will be apparent to the eye.

On Articles 54, 55. I do not believe it to be entirely true, though there is some truth in it, that bodies are fluid if their particles are agitated by various motions in all directions; that they are hard if their adjacent parts are mutually at rest in relation to each other; and that matter is not held together by any other glue than the quiescence of one part in relation to another. Descartes infers therefore that hardness, or, as I prefer to call it more generally, firmness (some of which there is even in soft bodies), arises from rest alone, because the glue or the cause of cohesion cannot be a body (for then the problem would repeat itself), and so it must be a mode of a body. But, he reasons further, rest is the only mode of a body which is fitting to explain this matter. Why so? Because rest is most contrary to motion. I marvel that so important a matter should be decided with so trifling and perfunctory, indeed, so sophistic, a reason. The syllogism would be:

> Rest is that mode of body which is most contrary to motion.
> But that mode of body which is most contrary to motion is the cause of firmness.
> Therefore rest is the cause of firmness.

But both premises are false, though each makes some tenuous display of truth. It happens too often in Descartes that, by assuming the most uncertain matters to be certain, he dismisses the careless reader by his dictatorial brevity; as when he concludes that extension constitutes matter, that thought is independent of matter, and that the same quantity of motion is conserved in nature--pronouncements based on authority rather than arguments. I am of the opinion that motion in the opposite direction is more contrary to motion than is rest and that a greater opposing force is required to reflect a body than merely to bring it to rest, as I have shown in Article 47. But the other premise would also have to be proved, namely, that what is most opposed to motion is the cause of firmness. Did the author by chance have in mind the following prosyllogism?

> Firmness is most opposed to motion.
> The cause of whatever is most opposed to motion is itself most opposed to motion.
> Therefore the cause of firmness is most opposed to motion.

But the premises of this prosyllogism are again both defective. Thus I deny that firmness is most opposed to motion; I admit that it is most opposed to the motion of one part without another, and it is the cause of this that he should have sought. Nor do I have any confidence in the axiom that the cause of whatever is opposed to a thing is itself also opposed to that thing. What is more opposed to death than life, but who would deny that death very often comes to an animal from a living being. No demonstration can be based upon such philosophical rules, which are entirely vague and not yet reduced to their proper limits.

There will be some who read this who will be offended at us for reducing such great philosophers to the limitations of Scholasticism by putting them in syllogisms; there will perhaps also be those who will condemn this as too trivial. But we have learned that these great philosophers, and indeed, often other men too, stumble on the most serious matters through neglect of this childish logic; in fact, they scarcely ever make mistakes in any other way. For what else does this logic contain than the most general dictates of supreme reason, expressed in rules that are easy to understand? It has seemed desirable to use this example, to show, for once, how useful such rules are for putting an argument into the prescribed form, so that the force of the argument may become apparent, especially in problems where the imagination does not come to the aid of reason as it does in mathematics, and where we are dealing with an author who puts great matters into precipitate arguments. Since Descartes does not help us with reasons in this problem, therefore, we must return to a consideration of the matters themselves.

In firmness, then, we must consider not so much rest as the force by which one part draws another along with it. Let two perfect cubes, A and B, be joined together and at rest with respect to each other, with their surfaces perfectly polished, and let cube B be placed to the left of cube A, with a surface of one congruent to a surface of the other, without any intervening

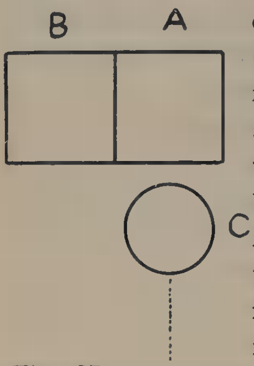

Fig. 27

space. Now let a small ball *C* strike the middle of cube *A*, in a direction parallel to the two congruent surfaces (Fig. 27). Then the direction of the blow will not reach cube *B* unless it is assumed to adhere to cube *A*. Of course *A* resists the colliding body *C* by its rest and cannot be moved by it without diminishing the force of *C*, and so it is also true that in this case *A* by its rest resists being separated from *B*. But this is *per accidens*, not because it is unconnected with *B*, but because it has to absorb the force of the blow itself, just as it would if *B* were entirely absent. So, once it has received this force, it will begin its own path, abandoning *B* just as if *B* were entirely absent from its vicinity. It is therefore a sophism to try to conclude that, because each thing perseveres in its own state as much as possible, it follows that two bodies at rest in relation to each other will mutually adhere and will have firmness from their mere state of rest. You might conclude with as much right that two bodies 10 feet apart are connected together and will strive to act so that they will always be 10 feet apart. A cause must therefore be found why two cubes *A* and *B* cohere sometimes and form a firm parallelopiped *AB* which moves as a whole when only the part *A* is impelled; or a cause must be found why the cube *A*, when moved, draws the cube *B* with it. Thus we seek the cause of traction in nature. There are, it is true, learned men who affirm that perfect unity is itself the cause of firmness, and it seems that this opinion satisfies some advocates of atoms. For if the parallelopiped is taken as an atom which is conceptually divisible into two cubes *A* and *B*, but is not really so divisible, they say that the parallelopiped is also actually indivisible and will remain firm always. Many objections may be made

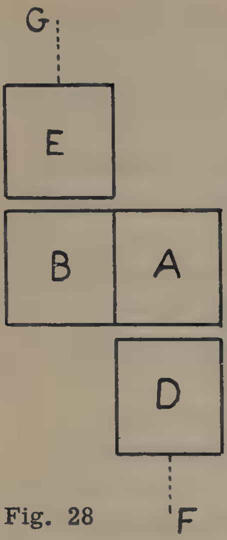

Fig. 28

to this; first of all, they offer no demonstration of their position. Let us assume that two atoms, D and E, which correspond to the cubes A and B with their anterior surfaces, strike simultaneously against the parallelopiped AB in directions parallel to the common surface of A and B, but with D coming from the back, from the direction of F, with its whole surface striking the entire congruent surface of A, and with E similarly coming from in front, in the direction from G, and striking B (Fig. 28). We seek a cause for A not leaving B and being propelled toward G, and for B not leaving A and being propelled toward F. I find no reason for this in the atomists' doctrine. For what else is there in the statement that a unity is composed of the two cubes A and B than that they are not actually divided? But if you hold, as do certain thinkers, that there are no parts in the continuum before actual division, it follows either that this does not prevent separation, namely, when a further reason is added which tends to produce an actual division, and so determines and distinguishes the parts as it were (the reason being the impact of the bodies D and E), or that no continuum can ever be broken into parts. Suppose then that two cubical atoms A and B, formerly distinct, approach each other so that two of their surfaces coincide; will there, at the moment of contact, be no difference at all between them and the atomic parallelopiped described above? Then two atoms would be held by each other through simple contact as if by some kind of glue, and the same thing would happen even if only parts of their surfaces touched. By a natural progression it would further follow from this that atoms would continuously increase like snowballs rolled through the snow, and the outcome, finally, would be that everything would coalesce into a more than adamantine hardness, and congeal into eternal ice, since the cause of coalescence would subsist, but not that of dissolution. For those who hold these views there remains one escape—to say that there are no plane surfaces in nature, or that, if there are any, they disappear in coalescence, but that all atoms terminate in curved surfaces, and these with the smallest possible areas of contact, as the case would be, for example, if all atoms were spherical, so that there would be no contact of any entire surfaces. But aside from the point that no adequate reason is given for excluding bodies with plane surfaces, or with other congruent surfaces, we again ask them to give us a reason why a continuum cannot be resolved into parts.

We have other strong arguments against atoms but do not propose to exhaust that matter here. There are those who explain the hardness of bodies by the same cause by which we see that two polished boards cannot be broken apart except with great force, the surrounding matter finding it impossible to penetrate so suddenly into the place to be relinquished by a separation of the boards. So they say that hardness arises from compression, which is right in most cases, but cannot be understood as a universal cause of hardness, because it again presupposes some hardness or firmness already to exist—that of the boards themselves. It is likewise irrelevant to say that the two cubes *A* and *B* are connected by some kind of glue, for some firmness is necessary in the glue itself by which its parts adhere both to each other and to the two bodies which they connect. But if anyone thinks that some kind of little projections pass over into *B* from *A*, penetrating into its small cavities, and also to *A* from *B*, and that this is the reason why the one cannot be moved without the other unless these points are broken, a new question arises: Whence the firmness of these points?

To pass over these theories, therefore, which either do not advance or do not solve the problem, I believe that the primary cause of cohesion is movement, namely, concurrent movement. (Evidently one must add impenetrability itself, when there is no place into which to give way, or when there is no reason for one body to give way rather than another; thus a perfect sphere which rotates in a uniform plenum at rest is prevented from throwing anything off by centrifugal force.) I believe that matter itself, which is homogeneous and equally divisible throughout, is differentiated by motion alone. We see that even fluids acquire a certain firmness when in motion. Thus a vigorous jet of water will prevent anything from breaking into its own path from without with more force than the same water at rest. For the irruption of new matter necessarily creates a strong disturbance in the co-ordinated motion, and force is necessary to produce this disturbance or to change the motion so greatly. If you touch a jet of water with your finger, you will see the little drops scatter in all directions with some violence, and you will also feel your finger repelled on entering the jet. We learn from the magnet, in an elegant experiment, that things which in themselves are separate and, so to speak, sand without lime, can acquire some firmness by motion alone. When iron filings are placed near a magnet, they suddenly become connected like a rope and form filaments, and the matter arranges itself in rows. It is no doubt also by some kind of magnetism, that is, by an internal co-ordinated motion, that other parts of certain bodies are linked together. This primary cause of consistency or cohesion therefore satisfies reason no less than the senses.

On Articles 56, 57. It is unnecessary to investigate the cause of fluidity, for matter is itself fluid except insofar as there are motions within it which are disturbed by the separation of certain parts. So it is not necessary for a fluid to be agitated by the varied motions of its particles. But since it is established on other grounds, by a general law of nature, that all bodies are agitated by internal motions, the conclusion is that bodies are firm insofar as these motions are concurrent, but remain fluid insofar as the motions are perturbed and not connected by any system. The result is that every body contains some degree of fluidity and some of firmness alike and that no body is so hard as not to have some flexibility, and the converse. Furthermore, this internal motion is insensible, since the parts which succeed each other continuously are not discernible by sense because of their smallness and similarity; moving rapidly, like a jet of water or the spokes of a wheel, they simulate one continuous solid. The internal motion of fluids is also confirmed by solutions of salt in water and by the corrosions which are made by acids and, indeed, also by heat in general. For, when heat is great, it causes liquids to boil, when it is only moderate it produces only an agitation, but when the agitation arising from heat is weakened, as it is in winter, then the permanent internal motion of the parts of matter acting in harmony alone predominates in most liquids; hence they harden and sometimes freeze solid. Another crude example of this strangely perturbed agitation of fluids is offered in the dust particles revealed by the sun's rays in an otherwise dark place. Moreover, since the fluids which seem according to our sense perception to be at rest are really in equally unhindered motion everywhere, and in all directions, it follows that their perturbed motion is so equally distributed and compensated for within them, as it were, that, when a solid is placed in such a fluid, it is assailed so equally on all sides by the blows and surges of the fluid that it is neither aided nor hindered in its own motion.

On Article 59. When a body is impelled by an external force in a fluid, the author thinks that this force, though in itself not enough to move the body, nevertheless does move it by concurring with particles of the fluid which support this motion and determines the remaining particles also to support it by retaining their own motion but changing its determination or direction. Add to this what the author says at the end of Article 56, and in his demonstration in Article 57. Hence he asserts that a hard body moving in a fluid does not obtain its whole motion from the hard body which impels it but also partly from the surrounding fluid. But soon he himself seems to demolish this in Article 60. In general, I believe that his remarks are to no purpose, because they rest upon a false principle (since he again speaks here as if rest were contrary to motion) and because they seem to have been thought up only to save the contradiction which phenomena show to the fourth rule of motion, in which our author has wrongly denied that a body at rest can be set in motion by a smaller one acting with any amount of velocity whatever (see the end of Article 61), whereas he himself was nevertheless forced to admit, in Article 56, that a hard body in a fluid is moved by the smallest force. So he makes use of this amazing comment to escape the difficulty and calls upon the particles of the fluid to help, but in vain, for since their motions from contrary directions compensate each other, they are of no avail. For if they had any effect, it would be too great and would give the movable object a motion greater than it can receive from the impelling force.

It is evident, however, that such a greater motion does not arise, and hence the movable body receives no more motion than if the fluid had not acted at all. Indeed, we must rather affirm the contrary—that far from motion being added by the fluid, some is rather subtracted by it, and the velocity of the moving body is diminished, partly because of the effect of a certain resistance but partly also from the mere fact that, when a hard body enters into a fluid, a part of the fluid equal to the volume of the body must continually be displaced and excited to new motion, and a certain part of the moving power must be expended to do this. I have elsewhere reduced the quantity of both kinds of resistance to calculation; one part of it is absolute and always the same in the same fluid, the other is relative and increases with the velocity of motion.[58]

On Article 63. Amazing are the considerations introduced here about the reason why our hands cannot break an iron nail. He finds a difficulty where there is none, and his answer is well adapted to his twisted objection. Certainly, if a resting body can be moved by a greater one, we may well ask why the hand cannot move a part of an iron nail much smaller than itself and admittedly at rest, and why it cannot tear it away from the rest of the nail. He attributes the cause to the softness of the hand, which therefore does not act upon the nail as a whole, but only with a part—and a part of the hand which is always smaller than the part of the nail to be broken off. Surely this is not a question of motion, for the hand easily moves not merely a part of the nail but the whole nail. It must rather be asked why a part of the nail draws the rest with it, and one part does not easily allow itself to be moved without the rest. Furthermore, it is useless to fall back on the softness of the hand, for even if we assume a blow by a piece of iron or stone, however large, in place of the hand, the parts of the nail will still cling together. Granted that a hard body is broken more easily by another hard one than by a soft one, we must nevertheless ask, not why or by what force the cohesion of two parts of a nail will be overcome, but why it exists. We must ask, not why one of them is moved by some greater body (for this is false), but why it is not easily moved alone.

On Article 64. The author closes his second part, which is a general part dealing with the principles of material things, with an observation which seems to me to need some restriction. He says, namely, that no other principles are necessary for the explanation of natural phenomena than those taken from abstract mathematics, or from the doctrine of size, figure, and motion, and that he recognizes no other matter than that which is the subject of geometry. I fully agree that all the particular phenomena of nature can be explained mechanically if we explore them enough and that we cannot understand the causes of material things on any other basis. But I hold, nevertheless, that we must also consider how these mechanical principles and general laws of nature themselves arise from higher principles and cannot be explained by quantitative and geometrical considerations alone; that there is rather something metaphysical in them, which is independent of the concepts which imagination offers and which is to be referred to a substance devoid of extension. For, in addition to extension and its variations, there is in matter a force or a power of action by which the transition is made from metaphysics to nature[59] and from material to immaterial things. This force has its own laws, which are derived from the principles not merely of absolute and, so to speak, brute necessity, as in mathematics, but from those of perfect reason.

Once these matters have been established in a general treatment, we may afterward, in accounting for natural phenomena, explain everything mechanistically, and it is as vain here to introduce the perceptions and appetites of an Archeus, operative ideas, substantial forms, and even minds, as it is to call upon a universal cause of all things, a deus ex machina, to move individual natural things by his simple will, as I recall the author of the Philosophia mosaica does by means of a fallacious interpretation of the words of Sacred Scripture.[60] Whoever considers these matters honestly will hold to the middle way in philosophy and do justice to theology as well as to physics. He will understand that the Scholastics sinned of old, not so much in holding to indivisible forms, as in applying them where they ought rather to have sought the modifications and instrumentalities of substance, and its mode of action, that is, mechanism. Nature has, as it were, an empire within an empire, a double kingdom, so to speak, of reason and necessity, or of forms and of the particles of matter, for, just as all things are full of souls, they are also full of organic bodies. These kingdoms are governed, each by its own law, with no confusion between them, and the cause of perception and appetite is no more to be sought in the modes of extension than is the cause of nutrition and of the other organic functions to be sought in the forms or souls. But that highest substance which is the universal cause of all brings it about, by its infinite wisdom and power, that two very different series in the same corporeal substance respond to each other and perfectly harmonize with each other, just as if one were ruled by the influence of the other. And if you observe the necessity of matter and the order of efficient causality, you will notice that nothing happens without a cause which satisfies our imagination, nothing which lies beyond the mathematical laws of mechanism; but if you contemplate the golden chain of ends and the circle of forms as an intelligible world, you will find that, since the apex of metaphysics and that of ethics are united in one by reason of the perfections of their supreme author, nothing happens without the highest reason. For the same God is the supreme form and the first efficient cause and the end or ultimate reason of the universe. But it is our part to revere his traces in nature and to meditate not merely upon his instruments in operating and the mechanical efficiency of material things but also upon the more sublime uses of his admirable craftsmanship; to know God, not merely as the architect of bodies, but above all as the king of minds, whose intelligence orders all things for the best and constitutes the universe as the most perfect state under the dominion of the most powerful and most wise Monarch. By thus combining both types of interpretation, we shall serve, in the consideration of the individual phenomena of nature, both our welfare in life and our perfection of mind, and wisdom no less than piety.

43

Correspondence with Huygens

1692-94
(Selections)

It was the Dutch mathematician and physicist Christian Huygens who helped Leibniz, in his Paris years, to master the literature of modern mathematics. It was also his discoveries in mechanics, in particular his early formulation of the laws of impact, and his later analysis of the compound pendulum, which provided the foundation for Leibniz's theories in dynamics. The correspondence between the two began in the Paris period (cf. Vol. I, No. 27) and continued until Huygens' death in 1695.

In the period in which the following letters were written, the correspondence dealt with the foundations of physical and cosmological theory, particularly in relation to the views of Descartes, whom both had already criticized, and of Newton. After his reading of the Critical Thoughts on the General Part of the Principles of Descartes (No. 42), Huygens selected for comment particularly those sections in which Leibniz reduced motion, on the one hand, and firmness, mass, and impenetrability, on the other, to force (Part II, Arts. 25 and 54-59). The correspondence moved from the problem of gravity and celestial motion to that of atoms and cohesion and eventually to the relativity of time, space, and motion. Leibniz's comments on Newton, many years before the charges of plagiarism became serious, are of historical interest.

* * *

I

[GM., II, 133-36]

Hanover, April 1/11, 1692

I hope that you have perfectly recovered from the indisposition of which you spoke in your last letter, and I wish for you good health that you may be able to finish the important meditations in which you are engaged. I will continue always to urge you to turn your thoughts to physics. I think I have shown more than once that your last treatises have pleased me infinitely. The explanation of Iceland spar is as it were a proof of the accuracy of your reasoning about light. There is in it only one circumstance about which you are not yet satisfied, but perhaps this will be cleared up later.

It appears very probable that gravity comes from the same cause which has made the earth round and which rounds off drops, namely, the circular movement of the ambient in every direction. And apparently this is also the reason for the attraction of the planets by the sun; entirely as if the planets preserve a certain magnetic direction like that which we see on earth. If we conceive of the attraction of heavy bodies as due to rays emanating from a center, we can explain why the weights of the planets are proportional reciprocally to the square of their distance to the sun, which is confirmed by phenomena. This law of weight, combined with the trajection of Mr. Newton, or with my theory of harmonic revolution, gives the ellipses of Kepler, also confirmed by phenomena. Now it is obvious that bodies are illumined by a luminous source in reciprocal proportion to the squares of their distances. I believe, further, that, according to this way of explaining gravity by the centrifugal force of a very subtle fluid, one can think of it as rays of attraction, these efforts of the fluid being no other thing in fact than such rays which force those bodies to descend whose circular motion is least rapid. It seems that in addition to this a kind of vortex is necessary in the heavens to explain the parallelism of axes. The spherical movement in all directions is not sufficient to do this; poles and meridians are needed. Finally, the correspondence which exists among the planets or satellites of the same system favors a common deferent liquid matter. . . .

. . . In rereading your explanation of gravity recently, I noticed that you are in favor of a vacuum and of atoms. I admit that I find it difficult to understand the reason for such infrangibility, and I believe that one must have recourse to a kind of perpetual miracle to explain this effect. Also, I do not see the necessity which compels you to return to such extraordinary entities. However, since you are inclined to accept them, you must have an important reason for it.

II

[GM., II, 141-46][61]

Hanover, September 16/26, 1692

I have been very busy this summer, which prevented me from replying earlier to your letter of July 11, for you touch on many important matters, which require a kind of retreat and meditation for their answer. For this reason I am not yet in a state to satisfy you entirely, but in the meantime I give you what I can.

I still cannot see why the many opinions about the roundness of drops, the weight of bodies on earth, and the attraction of planets toward the sun which seem to differ cannot be reconciled. I believe one can say in general that matter is somehow agitated in an infinity of ways from all sides, and with a uniform difformity, such that perhaps pressure is exerted equally in every direction. This motion should serve as well to form bodies as to determine their place. For bodies take that position in which their motions are least interfered with and adjust themselves to each other in some way. This can make them join together when they are separated and make it hard to separate them when they are joined. One can also consider, more particularly, that if a body is surrounded by another which is more fluid and more agitated, to which it does not permit a sufficiently free passage into its interior, it will be struck from without by an infinity of waves which will help to harden and to press its parts together. A spherical body is less exposed to the blows of this surrounding fluid, because its surface is the smallest possible and because the uniform diversity of its internal motions as well as the external motions contributes to this roundness. One can arrive at much greater detail in the case of the terrestrial globe and consider that the agitations of a confined fluid will be turned into rotations, for it is in this way that they continue with the least interference; and that these rotations take place in every direction, since the agitations which produce them do also. And the rotations which are adjacent to the earth are adjusted to each other and act harmoniously to have a common center, which will be that of the terrestrial globe, doubtless because, from the formation of this globe, which was apparently similar to the formation of a drop, this center was distinguished from its other points; this rotating matter strives to draw away from the center and, as a result, will force less agitated bodies to approach it. And the centrifugal pull of matter can be considered as rays of attraction leaving the center as compared with the bodies which they make approach that center. The analogy of nature may lead us to believe that there is something approaching this in the nature of the solar system—that the planets tend toward the sun for a similar reason and that their attractions are in the ratio of the inverse squares of their distances, as in illumination. And since there is a great analogy between the earth and a magnet, and since there is not only attraction but also direction in the magnet, there is ground for believing that among all the rotations around the center of the earth, to which an infinity of poles can be assigned, there are two principal poles with respect to which the matter of the earth is adjusted to a certain course of the matter in the great solar system, as magnets adapt themselves to the course of the matter of the terrestrial system.

It seems, Sir, that you do not approve of these efforts at generalization, but you do not point out any particular fault which you find in them. You also do not say, for instance, why you ascribe the roundness of water drops, more particularly, to a rapid motion within them. Nor do you say why the centrifugal efforts of matter cannot be considered as rays of attraction. Yet I have noticed something which could have been said in reply, namely, that there is the same quantity of light in all concentric spherical surfaces, but it can be doubted that there is the same quantity of attraction. It is true that this attempt of mine also seems plausible enough when we consider the speed of rotation. We must examine which explanation is the better or if they can be reconciled. The same thing can be said in regard to Mr. Newton's explanation of ellipses. Planets move as if there were only one motion of trajection or of proper direction, combined with gravity, as he has observed. Yet they also move as if they were carried along smoothly by a matter whose circulation is harmonious, and it seems that this circulation works in harmony with the proper direction of the planet. The reason why I cannot abandon this deferent matter, even after learning Mr. Newton's explanation, is, among other things, that I find that all the planets move somewhat in the same direction and in a single region, a thing which applies even to the satellites of Jupiter and Saturn. Without this deferent matter, on the other hand, nothing would prevent the planets from going in every direction. There are many things to be said about all this, which I hope to clear up more definitely some day.[62] . . .

. . . I come to our difference on the void and the atoms, which it will be difficult to avoid.[63] You assume, Sir, that there is a certain primitive firmness in bodies, and, because this is so, you conclude that this must be infinite, since there is no reason whatever to assume it of a definite degree. I agree that it would be absurd to ascribe a certain degree of firmness to all bodies, for there is nothing to determine one degree of this kind rather than another. But it is not absurd to ascribe different degrees of firmness to different bodies; otherwise one could prove by the same reason that bodies must have either a zero velocity or an infinite velocity. If it be assumed that nature must vary, reason demands that there be no atoms or bodies of an infinite firmness at all; otherwise they would all be infinitely firm, which is not at all necessary. It seems also that you have not satisfactorily answered the difficulty involved in atoms which touch each other by some surface, thereby remaining caught and inseparably attached to each other. For to deny that atoms have flat surfaces or surfaces which otherwise fit each other, even if only in their smallest parts, is a questionable assumption. But, even if we admit this, I believe that in reasonings of this kind we should consider not only what is but also what is possible. Let us assume the possibility, therefore, that all atoms have only plane surfaces; then it is clear that this difficulty about their cohesion arises and that consequently the hypothesis of perfect hardness is unreasonable.[64] There are still other difficulties in the atoms. For example, they cannot obey the laws of motion, for the force of two equal atoms which collide directly and with an equal velocity must be lost, since it would seem that it is only elasticity which makes bodies rebound. But even if there were no difficulty, it seems that we ought not to admit a quality such as primitive firmness without a reason. There is nothing to be seen which attaches two masses together, and I do not see how you, Sir, can conceive that the contact alone can serve as a kind of cement.[65] Now, since there is no natural connection whatever between contact and attachment, it must follow that, if contact is followed by adhesion, this happens by a perpetual miracle. But if firmness is to be an explicable quality, it must come from motion, since it is only motion which distinguishes bodies. If this is assumed, everything which I can say of the original connection of bodies reduces to this—that force is necessary to detach one part of matter from another, since this detachment changes the motion and the present course of bodies. In a mass the motion of all its parts acts in harmony insofar as there is some rule or law to compare the moving parts with each other, and the mass is disturbed in the measure in which this rule becomes more composite. One can also say that every body has a certain degree of firmness and of flexibility. Yet, when some iron bar or other large body is considered, it is unnecessary to have recourse at once to the primitive origin of firmness, any more than to atoms; it suffices to make use of little bodies, each of which already possesses firmness within it, but each of which remains attached to the others, a little like two boards which touch each other with their flat surfaces and which the surrounding pressure prevents from suddenly parting.

I am not at all eager to publish my remarks on the general part of Descartes's philosophy. Mr. de Beauval seems to offer to take them to Holland with him. Since you have taken the trouble to examine them, I wish that you had noted the passages with which you do not agree, beyond those which consider the void and firmness. I wish that some able Cartesian who has retained his capacity to reason could also examine them, so that I might learn what he would say in opposition. I have written this to Mr. de Beauval. I hope some day to see what you will say about motion. I have examined the Principles of Descartes with the aid of a general principle of agreement which has no defects, in my opinion, and which seems useful for refuting errors while preparing for the pure truth. By means of this principle, it was easy to show how the Cartesian rules of motion refute themselves. My design in these comments was only to make critical observations on Descartes, without claiming to give the true philosophy. . . .

III

[GM., II, 179-85]

Hanover, June 12/22, 1694[66]

I am greatly pleased to receive the honor of your letter after so long an absence. But I am careful not to complain, for I well know how precious your time is. And, besides, I shall always be ardent in exhorting you to guard your health, especially since I learn from your letter that it has been a little irregular. Would to God that our studies might serve to make considerable advances in medicine. But until now this science is almost entirely empirical. It is true that even empiricism would be of great use if men were interested in observing well, or even in making good use of all the observations already made. But, since medicine has become a business, those who make it their profession do so only by way of gain and as far as is necessary to save appearances, knowing well that few people are capable of passing judgment upon what they are doing. I wish that some religious order such as the Capuchins, for example, would devote itself to medicine on the principle of charity. Well administered, such an order could carry it far. But enough of these useless wishes; let us come to the points in your letter.

I wish the public might soon learn the particulars of your clock, for they cannot fail to be of great importance. As for your treatment of a philosophical matter, I should be pleased sometime to learn what it can be.[67] You have been too reserved until now in wishing to publish nothing but demonstrations, whereas men of your power ought not to withhold even their conjectures. This is why you will do only good by expressing your opinions on all kinds of matters, even philosophical and problematical. Your exhortation confirms me in the purpose I have of producing a treatise explaining the foundations and applications of the calculus of sums and differences and some related matters. As an appendix I shall add the beautiful insights and discoveries of certain geometricians who have made good use of my method, if they will be so kind as to send them to me. I hope that the Marquis de l'Hospital will do me this favor if you judge it fitting to suggest it to him. The Bernoulli brothers could also do it. If I find something in the works of Mr. Newton which Mr. Wallis has inserted in his algebra which will help get us forward, I shall make use of it and give him credit.[68]

But I venture to ask that you yourself will favor me with what you judge appropriate, as, for example, your analysis of Mr. Bernoulli's problem by means of this kind of calculus. . . .

. . . I do not know if I have told you that Mr. Fatio[69] has communicated to me some of his thoughts about a mechanical explanation of Mr. Newton's opinions. It is true that he has done this only reservedly and in riddles. He believes that matter fills only a very small part of space and that bodies are open structures like skeletons to permit easy passage. He believes too that, if space were filled with an inert fluid matter in every direction, this would greatly interfere with the motion of bodies. He speaks of the objection which you have made, namely, that matter should then grow thick around the earth and so stop it, but says that this objection vanishes when it is examined carefully and that Mr. Huygens (so he adds) is now convinced of this. In this, he says, something admirable transpires which must be commented on before one can see that your objection has no substance.

It seems in this case that a circulation or reciprocal motion occurs in nature, such that a subtle but dense or compressed matter, as it moves away from the bodies which attract others, forces the larger matter to approach these bodies. But, when this gross matter arrives, it is ground up and made subtle and so sent back directly to the circumference, where it is again dispersed and serves as food for other gross bodies. There may be many reasons for attraction, such as centrifugal force arising from a circular motion, which you have used, but also the straight motion of corpuscles in about the sense in which I once saw them described by an author who tried to explain on this basis the firmness of bodies and phenomena commonly ascribed to the weight of air, but which you have observed in a vacuum. Since it seems that the mass of the earth must act in such a way that more corpuscles tend to strive toward it than can arrive, one could say that this would push the body toward the earth, according to the opinion of earlier men whom you have noted. To these factors can also be added explosion, like that of an infinity of air rifles [*arquebuses a vent*]. For could it not be said that the bodies which produce light, weight, and magnetism are still coarse in comparison with those which produce only their own force and that the latter thus inclose a compressed matter but that, when they arrive at the sun or toward the center of other bodies which make an emission (whose interior would thus be like the sun), the great movement which this body exerts breaks and unbinds them and frees the matter compressed in them? It seems in fact that it is from this matter that fire comes. There may also be many factors combined to cause weight, since nature works in such a way that everything is in as much agreement as is possible. However this may be, it will always be difficult for us to determine these things. If anyone could succeed in our time, it would be you. It is true that all ethereal matter which tends toward the earth or toward some other body without penetrating it could not return from it. For that which does not penetrate will rebound and strike some other matter arriving behind it. Thus matter must be mixed together and pack itself around the body. But perhaps the mass thus formed is at once dissipated, a little like the sunspots.

As for the difference between absolute and relative motion, I believe that if motion, or, better, the motive force of bodies, is something real, as it seems we must acknowledge, it is necessary for it to have a *subject*. For if *a* and *b* approach each other, I assert that all the phenomena involved will happen in the same way, regardless of which one the motion or rest is assigned to. Even if there were a thousand bodies, I still hold that the phenomena could not provide us (or angels) with an infallible basis for determining the subject or the degree of motion and that each body could be conceived separately as being at rest. And I believe that this is all that you ask. But you will not deny, I think, that each body does truly have a certain degree of motion, or, if you wish, of force, in spite of the equivalence of these hypotheses about their motion. It is true that from this I draw the conclusion that there is something more in nature than what geometry can determine about it. This is not the least important of the many arguments which I use to prove that besides extension and its variations, which are purely geometrical things, we must recognize something higher, namely, force. Mr. Newton recognizes the equivalence of hypotheses in the case of rectilinear motions but believes that in the case of circular motions the efforts which the bodies exert to depart from the center or the axis of rotation compel us to recognize their motion as absolute. But there are reasons which make me believe that nothing breaks the general law of equivalence. It seems to me, however, that you yourself, Sir, were once of Newton's opinion in regard to circular motion. . . .

P.S. I do not know when I shall see the work which Mr. Wallis has just published. Would you do me the favor, Sir, of having the passages in which Mr. Newton gives his new discoveries copied for me? I do not ask directly for his method of finding series, but whether he gives the methods for converse tangents or something similar. In writing me earlier, he concealed his method in transposed letters. He indicated that he had two methods, one more general, the other more elegant. I do not know if he has spoken of them here.

IV

[GM., II, 193-99]

Hanover, September 4/14, 1694[70]

I begin by thanking you for communicating to me the extract from Mr. Wallis' work which concerns Mr. Newton. I see that his calculus agrees with mine, but I think that the consideration of differences and sums is more fitted for enlightening the mind, since it occurs also in the ordinary series of numbers and in a way corresponds to powers and roots. It seems to me that Mr. Wallis speaks rather coolly of Mr. Newton and implies that it would be easy to derive these methods from Barrow's lectures. When things are done, it is easy to say, "Et nos hoc poteramus."[71] Complex matters cannot so easily be disentangled by the human mind without the use of characters. I am also pleased to see, at last, the deciphering of the enigmas contained in Mr. Newton's letter to the late Mr. Oldenburg. But I am sorry not to find the new lights which I had promised myself on inverse tangents. For this is nothing but a method for expressing the value of the ordinate of a sought curve through infinite series, the basis for which I already knew in those early days, as I then testified to Mr. Oldenburg. Some time ago I published this method in the Leipzig *Acts*, in an easy and very general form. . . .

. . . When I told you in Paris that it is difficult to know the true subject of motion, you replied that this could be done by means of circular motion. This interested me, and I remembered it when I read almost the same thing in Mr. Newton's book. But this was after I had already seen that circular motion has no advantages in this respect. I see that you are now of the same opinion. I hold, then, that all hypotheses are equivalent and that, when I assign certain motions to certain bodies, I do not have, and cannot have, any other reason but the simplicity of the hypothesis which I choose, for I believe that one can hold the simplest hypothesis (other things being equal) for the true one. Since I have no other criterion, therefore, I believe that the difference between us is only in our manner of speech, which I try to accommodate as far as I can to popular usage, *salva veritate*. I am not far from your opinion, and I have adapted myself to it in a small paper which I have sent to Mr. Viviani, and which seems to me appropriate to persuade the gentlemen at Rome to allow Copernicus' hypothesis.[72] But if you hold these views about the reality of motion, I imagine your views about the nature of body should also be different from those customarily held. My views are rather unusual but seem to me to be demonstrated. I hope some day to learn your opinions about my *Critical Thoughts against Descartes*, which you have given me hope of receiving, and also about what I have sent you in opposition to atoms and the void. . . .

44

From the Ethical and Legal Writings

1693-1700

Of the four studies given here, only the first two, selected from the prefaces of Leibniz's two published collections of medieval state documents, can be dated. The third, however, is also probably from the last decade of the seventeenth century, though its theme occurs much earlier in Leibniz's thought. The fourth selection, Leibniz's notes on Felden, is earlier.

One of the fruits of the journey of historical research in 1687-90 was the collection which Leibniz made of historical documents of importance for European history and law. Impressed by the materials available through his own work and in the library at Wolfenbüttel, and invited by the Vienna librarian, Nesse, to supplement the catalogue of state documents there, he decided to publish his own collection in competition with a similar plan pushed forward in Paris by Leonard. The *Codex juris gentium diplomaticus* appeared in 1693, the *Mantissa codicis juris gentium* in 1700. His concern for European peace was conspicuous in the Preface of the earlier work, which discussed also the importance of accurate and reliable sources for the understanding of historical causes, and as a basis for "the law of nature and of nations," in contrast with the "voluntary law" based on contracts between sovereigns and assuring only armistices rather than enduring peace.

* * *

I

From the Preface of the CODEX JURIS GENTIUM DIPLOMATICUS

1693

(Selection)

[G., III, 386-89]

Even after the efforts of so many famous authors, I am not sure that the notions of *Right*[73] and *justice* have been made sufficiently clear. *Right* is a kind of moral power, and *obligation* is moral necessity. By *moral*, however, I mean something equivalent to natural for a good man, for, as a Roman jurisconsult has well said, we should believe that we are incapable of doing things which are contrary to good morals. A good man is one who loves all men, so far as reason permits. Therefore, if I am not mistaken, we may most fittingly define *justice*, which is the virtue governing that affection which the Greeks call *philanthropy*, as the *charity* of the wise man, that is, as charity which follows the dictates of wisdom. So the assertion attributed to Carneades, that justice is the highest folly because it bids us consider the interests of others while neglecting our own, is based on ignorance of its definition.[74] *Charity* is universal benevolence, and *benevolence* is the habit of loving or of cherishing. But to love or to cherish is to find pleasure in the happiness of another, or, what amounts to the same thing, to accept the happiness of another as one's own. Thus the knotty question of how there can be a disinterested love which is free from hope and fear, and from every consideration of utility, is solved, and in a way that is also of great importance in theology.[75] For the happiness of those whose happiness pleases us is obviously built into our own, since things which please us are desired for their own sake. Thus the contemplation of beautiful things is itself pleasant, and a painting of Raphael affects him who understands it, even if it offers no material gains, so that he keeps it in his sight and takes delight in it, in a kind of image of love. But, when the beautiful object is at the same time itself capable of happiness, this affection passes over into true love. The divine love, moreover, excels over other loves because God can be loved with the happiest result, since nothing is happier than God, and at the same time nothing can be conceived more beautiful and more worthy of happiness. And since he possesses supreme power and supreme wisdom, his happiness is not only built into ours, (if we are wise; that is, if we love him), but it also constitutes ours. But since wisdom should guide charity, we also need a definition of wisdom. I believe, however, that we will best satisfy the concept men have of it if we say that wisdom is nothing but the science of happiness itself. So we come back again to the notion of happiness, which this is not the place to explain.

Now from this source is derived natural right, of which there are three degrees: strict right [jus strictus] in commutative justice; equity (or charity in the narrower sense of the term) in distributive justice; and, finally, piety (or probity) in universal justice. Hence the three most general and commonly accepted precepts of right: to injure no one, to give to each his due, and to live honorably (or, better, piously), as I once suggested as a youth in a book on the method of the law.[76]

The precept of mere right or strict right is that no one is to be injured, lest he be given ground for legal action if a member of the state, or the right of war if he is outside the state. From this arises the justice which philosophers call commutative, and the right which Grotius calls a legal claim [facultas].[77]

The higher degree I call equity, or, if you prefer, charity (that is, in the narrower sense). This I extend beyond the rigor of strict right, to include those obligations which give to those whom they affect no ground for action in compelling us to fulfil them, such as the obligation of gratitude and of almsgiving. Upon these, Grotius says, we have a moral claim [aptitudo], not a legal claim [facultas]. And as the lowest degree of right is to harm no one, so the middle degree is to do good to all men, but only so far as befits each one or as much as each deserves, since we cannot befriend all men equally. It is therefore here that distributive justice belongs and the precept of the law that commands us to give each one his due. And it is here that the political laws in a state belong, which assure the happiness of its subjects and which usually bring it about that those who had merely a moral claim acquire a legal claim, that is, that they become able to demand what it is equitable for others to perform. In the lowest degree of right, the differences among men are not considered, with the exception of those which arise from each particular case, but all men are counted as equals. Now, however, on this higher level, merits are weighed, and so privileges, rewards, and punishments have their place. Xenophon has nicely suggested this difference between the degrees of right, in his example of the boy Cyrus, who was chosen to act as judge between two boys, the stronger of whom had forcibly exchanged garments with the other because he found that the other's coat fitted him and his own fitted the other better. Cyrus pronounced in favor of the robber. But his instructor reminded him that the question at this point was not whom the coat might fit, but only to whom it belonged, and that he might more properly use this other form of judgment only when he himself had coats to distribute. For equity itself recommends strict right, or the equality of men, to us in our dealings, except when an important consideration of greater good commands us to depart from it. What is called respect of persons, however, has its place, not in exchanging goods with others but in distributing our own or the public goods.

The highest degree of right I have named probity, or rather piety. What I have said thus far can be so interpreted as to be limited to the relations within mortal life. Mere right or strict right, indeed, arises from the principle of preserving peace; equity or charity strives for something more—that, while each benefits the other as much as he can, he may increase his own happiness in that of the other. In a word, strict right avoids misery, whereas the higher right tends toward happiness, but only such as falls within this mortality. But that we ought to hold this life itself, and all that makes it desirable, second to the great advantage of others, so that it behooves us to bear the greatest pains for the sake of others—this is beautifully taught by philosophers rather than firmly demonstrated. For the dignity and glory, and the joyous sense which our mind has of virtue, to which they appeal under the name of honor [*honestas*], are certainly goods of thought or of the mind, and, indeed, great ones. But they are not such as prevail over all men, or over all the bitterness of evils, since not all men are equally moved by the imagination, especially those who have not grown used to the weighing of virtue or the cherishing of goods of the mind, whether through a liberal education, or the habit of living as free men, or the discipline of life or of sect. In order really to establish by a universal demonstration that everything base is harmful, we must assume the immortality of the soul and the ruler of the universe, *God*. Thus it is that we

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may think of all men as living in the most perfect state, under a monarch who can neither be deceived in his wisdom nor eluded in his power, but who is also so lovable that it is happiness to serve such a lord. Hence whoever expends his soul for him, as Christ teaches, shall gain it. His power and providence bring it to pass that every *right* passes over into fact, that no one is injured except by himself, and that no right deed is without its reward, no sin without its punishment. As we are divinely taught by Christ, all our hairs are numbered, and not even a drink of water is given to the thirsty in vain; thus nothing is neglected in the commonwealth of the universe. It is on this ground that *justice* is called *universal*, and includes all other virtues, for duties that do not otherwise seem to concern others, as, for example, not to abuse our own bodies or property, though they lie beyond human laws, are yet prohibited by the law [*jus*] of nature, that is, by the eternal laws of the divine monarchy, since we owe ourselves and our all to God. For if it is of interest to the state that no one should make bad use of his property, how much more to the interest of the universe! And so it is from this that the highest precept of the law receives its force, which commands us to *live honorably* (that is, piously). It is in this sense that learned men have rightly set down, among things to be desired, that the law of nature and the law of nations should follow the teachings of Christianity, that is, τὰ ἀνώτερα, the sublime matters, the divine things of the wise, after the pattern of Christ. In this way I believe that I have interpreted the three precepts of the law, or the three degrees of justice, in the most fitting way and have pointed out the sources of natural law.

Besides[78] the eternal right of a rational nature, which flows from this divine source, there is also held to be a *voluntary right*, which is derived from custom or established by a superior. And within the state, civil law does indeed receive its force from him who has the supreme power; outside of the state, or among those who take part in the supreme power (of whom there may also be several within the same state), is the sphere of the *voluntary law of nations*, which is derived from the silent consensus of the peoples. It is not necessary for this to be the consensus of all peoples or of all times, for there have been many cases in which one thing was judged right in India and another in Europe, and even among ourselves it has changed with the course of centuries, as this work itself will show. . . .

But Christians have still another bond, the positive divine law contained in the sacred writings. To these are to be added the sacred canons accepted by the whole church and, later, in the West, the papal law, to which kings and peoples make submission. In general, before the schism of the past century, it seems to have been accepted for a long time, and not without reason, that we must think of a kind of commonwealth of Christian nations, the heads of which are the pope in sacred matters, and the Holy Roman emperor in temporal affairs. These seem to have retained as much of the old Roman law as was needed for the common good of Christendom, without prejudice to the right of kings and the liberty of princes. . . .

II

From the Preface to the MANTISSA CODICIS JURIS GENTIUM[79]

1700

. . . It seems desirable, however, to reply to one objection which has been made to me, on an issue upon which I touched there [in the Preface of the Codex] before it was openly discussed, and which recently excited much argument in France, until it was suppressed by authority of the king and the supreme pontiff.[80] This is the controversy about whether love which is disinterested, and seeks the well-being of the beloved, nevertheless depends upon the impulsion toward one's own well-being. Somewhat the same question, namely, had occurred to me when I prefaced the Codex juris gentium with some remarks on the foundation of law, which I tried to find in charity, since justice is nothing but the charity of a wise man. For how can love be bestowed upon others? Who seeks the well-being of the beloved for its own sake, since we will nothing except for the sake of our own good?

I should answer that whatever is pleasant is sought for itself, as opposed to what is useful, that is, to the good ends of producing the well-being of another. I observed that such is the object of true love, since to love or to cherish is to be delighted by the happiness of the beloved and his perfections. I understood the following objection to have been made against this—that it is more perfect so to submit to God that you are moved by his will alone and not by your own delight. But we must recognize that this conflicts with the nature of things, for the impulse to action arises from a striving toward perfection, the sense of which is pleasure, and there is no action or will on any other basis. Even in our evil purposes we are moved by a certain perceived appearance of good or perfection, even though we miss the mark, or rather pay for a lesser good, ill sought, by throwing away a greater. Nor can anyone renounce (except merely verbally) being impelled by his own good, without renouncing his own nature. And so it is to be feared that the negation of self which certain false mystics teach, and the suspension of action and thought by which they assume that we find supreme union with God, may end at length in a doctrine of the mortality of the soul such as is taught by the Averroists and other old philosophers as well, to whom it seemed that minds do not persist after man's death, except in that ocean of divinity from which the drops had once come forth. I seem to observe the seeds of this doctrine in Valentine Weigel, in the so-called Angelus Silesius, and in Molinos, though perhaps these authors do not themselves adequately recognize it.[81] So we rightly reject the lazy reason [ἀργὸς λὸγος] of men, the philosophic opinion of those who locate perfection in quietude, that is, in cessation, and who thus withdraw far from true tranquillity and charity and far, too, from Telemachus himself.[82]

III

ON WISDOM[83]

[Guh. DS., I, 420-26; G., VII, 86-87]

Wisdom is merely the science of happiness or that science which teaches us to achieve happiness.

Happiness is a state of permanent joy. The happy man does not, it is true, feel this joy at every instant, for he sometimes rests from his contemplation, and usually also turns his thoughts to practical affairs. But it is enough that he is in a *state* to feel joy whenever he wishes to think of it and that at other times there is a joyousness in his actions and his nature which arises from this.

Present joy does not make happy if it has no *permanence*; indeed, he is rather unhappy who falls into a long wretchedness for the sake of a brief joy.

Joy is a pleasure which the soul feels in itself. *Pleasure* is the feeling of a perfection or an excellence, whether in ourselves or in something else. For the perfection of other beings also is agreeable, such as understanding, courage, and especially beauty in another human being, or in an animal or even in a lifeless creation, a painting or a work of craftsmanship, as well. For the image of such perfection in others, impressed upon us, causes some of this perfection to be implanted and aroused within ourselves. Thus there is no doubt that he who consorts much with excellent people or things becomes himself more excellent.

Although the perfections of others sometimes displease us—as, for example, the understanding or the courage of any enemy, the beauty of a rival, or the luster of another's virtue which overshadows or shames us—this is not because of the perfection itself but because of the circumstance which makes it inopportune for us, so that the sweetness of our first perception of this perfection in someone else is exceeded and spoiled by the consequent bitterness of our afterthoughts.

We do not always observe wherein the perfection of pleasing things consists, or what kind of perfection within ourselves they serve, yet our feelings [Gemüth] perceive it, even though our understanding does not. We commonly say, "There is something, I know not what, that pleases me in the matter." This we call "sympathy." But those who seek the causes of things will usually find a ground for this and understand that there is something at the bottom of the matter which, though unnoticed, really appeals to us.

Music is a beautiful example of this. Everything that emits a sound contains a vibration or a transverse motion such as we see in strings; thus everything that emits sounds gives off invisible impulses. When these are not confused, but proceed together in order but with a certain variation, they are pleasing; in the same way, we also notice certain changes from long to short syllables, and a coincidence of rhymes in poetry, which contain a silent music, as it were, and when correctly constructed are pleasant even without being sung. Drum beats, the beat and cadence of the dance, and other motions of this kind in measure and rule derive their pleasurableness from their order, for all order is an aid to the emotions. And a regular though invisible order is found also in the artfully created beats and motions of vibrating strings, pipes, bells, and, indeed, even of the air itself, which these bring into uniform motion. Through our hearing, this creates a sympathetic echo in us, to which our animal spirits respond. This is why music is so well adapted to move our minds, even though this main purpose is not usually sufficiently noticed or sought after.

There can be no doubt that, even in touch, taste, and smell, sweetness consists in a definite though insensible order and perfection or a fitness, which nature has put there to stimulate us and the animals to that which is otherwise needed, so that the right use of all pleasurable things is really brought about in us, even though these things may give rise to a far greater harm through abuse and intemperance.

I call any elevation of being a perfection. Just as illness is a debasement, as it were, and a decline from health, so perfection is something which rises above health. But health itself stands balanced in the middle and lays the foundation for perfection. Now, illness comes from an injury to action, as medical men rightly observe. Just so perfection shows itself in great freedom and power of action, since all being consists in a kind of power; and, the greater the power, the higher and freer the being.

The greater any power is, moreover, the more there is found in it the many revealed through the one and in the one, in that the one rules many outside of itself and represents them in itself. Now unity in plurality is nothing but harmony [Uebereinstimmung], and, since any particular being agrees with one rather than another being, there flows from this harmony the order from which beauty arises, and beauty awakens love.

Thus we see that happiness, pleasure, love, perfection, being, power, freedom, harmony, order, and beauty are all tied to each other, a truth which is rightly perceived by few.

Now when the soul feels within itself a great harmony, order, freedom, power, or perfection, and hence feels pleasure in this, the result is joy, as these explanations show. Such joy is permanent and cannot deceive, nor can it cause a future unhappiness if it arises from knowledge and is accompanied by a light which kindles an inclination to the good in the will, that is, virtue. But when pleasure and joy are directed toward satisfying the senses rather than the understanding, they can as easily lead us to unhappiness as to bliss, just as a food which tastes good can be unwholesome. So the enjoyment of the senses must be used according to the rules of reason, like a food, medicine, or exercise. But the pleasure which the soul finds in itself through understanding is a present joy such as can conserve our joy for the future as well.

It follows from this that nothing serves our happiness better than the illumination of our understanding and the exercise of our will to act always according to our understanding, and that this illumination is to be sought especially in the knowledge of such things as can bring our understanding ever further into a higher light. For there springs from such knowledge an enduring progress in wisdom and virtue, and therefore also in perfection and joy, the advantage of which remains with the soul even after this life.

A separate discussion would be needed to show what the things are whose knowledge causes so happy a progress. Meanwhile we can say that no one can rise more easily to a higher stage of happiness than can persons of rank, yet that no one finds it more difficult than they actually to achieve this happiness, as Christ himself tells us. The reason is that, though they have the power to do much good, they rarely put their minds to it. For having opportunities constantly for sensual indulgence, they grow used to seeking their joys mostly in the pleasures which come from the body. And even when they rise higher, they seek praise and honor from others more than a true satisfaction within themselves. Hence their self-deceit ends when the pleasures of the body are destroyed by illness, and their glory by misfortunes, and they find that they are unhappy. From their youth they have followed the drive of external things for the sake of the pleasure which they found in it, and especially because it is hard, at first, to resist this stream. Thus they have for the most part lost their freedom of mind.

It is a great thing, therefore, when a person of rank can enjoy himself even in illness, misfortune, and disgrace,[84] especially if he can find contentment, not out of necessity, because he sees that things must be as they are (this is no more comfort than that of taking a sleeping potion to escape feeling pain), but out of the awakening within himself of a great joy which overcomes these pains and misfortunes.

Such joy, which a person can always create for himself when his mind is well ordered, consists in the perception of pleasure in himself and in the powers of his mind, when a man feels within himself a strong inclination and readiness for the good and the true, and particularly through the profound knowledge which an enlightened understanding provides for us, namely, that we experience the chief source, the course, and the purpose of everything, and the incomprehensible excellence of that Supreme Nature which comprises all things within it. Thus are we lifted above the unknowing, just as if we were looking down from the stars and could see all earthly things under our feet. Then at last we learn that we have reason to find the highest joy in all things that have happened and are yet to happen, but that we must also seek, as far as is in our power, to direct what has not yet happened for the best. For it is one of the eternal laws of nature that we shall enjoy the perfection of things and the pleasure which results from it, only in the measure of our knowledge, our good will, and our contribution to this perfection.

When a person of rank attains this and finds his joy in the actions of his understanding and his virtue, even in the midst of all abundance and honor, I consider him doubly exalted. He is exalted unto himself because of this, his happiness and true joy; he is exalted before others because it is entirely certain that such a person can and will share his light and virtue with many others because of his power and reputation, since such sharing will reflect glory upon himself and so give new light to all those who have the same common purpose of helping each other in the search for truth, the knowledge of nature, the multiplication of human powers, and the advancement of the common good.

The great happiness of persons who are both exalted in rank and enlightened as well is therefore apparent, because they can do as much for their happiness as if they had a thousand hands and a thousand lives—indeed, as if they lived a thousand times as long as they do. For only so much of our life is to be valued as truly living as the good we do in it. One who does much good in a short time is thus equal to one who lives a thousand times as long. This is the case with those who can make thousands upon thousands of hands work with them, so that more good can be brought about in a few years, to their supreme glory and enjoyment, than could otherwise be achieved in many hundreds of years.

The beauty of nature is so great, its contemplation is so sweet, and the light and good inclination which arise from these bring such glorious fruitage even in this life that he who has tasted them considers all other delights small by contrast. But when we add that the soul does not perish but that every perfection within her must be preserved to bring forth fruit, then it can be seen in full how the true happiness which arises from wisdom and virtue is incomparably and immeasurably high above all that we may imagine about it.

IV

ON NATURAL LAW[85]

[Guh. DS., I, 414-19]

Justice is a social virtue, or a virtue which preserves society.

A society is a union of different men for a common purpose.

A natural society is one which is demanded by nature.

The signs by which one can conclude that nature demands something are that nature has given us a desire and the power or effectiveness to fulfil it, for nature does nothing in vain, especially when the matter involves a necessity or a permanent benefit, for nature everywhere achieves the best.

The most perfect society is that whose purpose is the universal and supreme happiness.

Natural law is that which preserves or furthers natural societies.

The first natural society is that between man and woman, for it is necessary to preserve the human race. The second is between parents and children; this arises at once out of the first, for when children are procreated or freely adopted, they must be reared, that is, governed and nourished. In return they owe their parents obedience and help after they are reared. For such a society is conceived and furthered by the hope of this gratitude, though nature maintains it principally for the sake of the children—that they may sometime achieve perfection. Parents exist primarily for the sake of children; the present, which does not last long, for the sake of the future.

The third natural society exists between master and servant. This is natural when a person lacks understanding but does not lack strength to nourish himself. Such a person is by nature a servant who must work as another directs him. From his work he receives his maintenance; the rest belongs to his master. For, whatever the servant is, he is for the sake of his master, since all other powers exist for the sake of the understanding. But understanding is in the master, only the other powers are in the servant. Since such a servant exists for the sake of his master, his master owes him only his maintenance, and that for his own sake, in order not to ruin his servant.

This might be understood if there were no hope of bringing the servant himself to understanding; otherwise the master would be obligated to advance his servant's freedom through education, at least as far as this is necessary for the happiness of the servant. To confess the truth, I doubt whether an instance can be found of a servitude such that the servant exists entirely for the sake of the master, especially since souls are immortal and hence can sometime achieve understanding and the blessedness of a life based upon it. In my opinion, therefore, this society exists only between men and cattle. For even if a man were born entirely brutish and incapable of any instruction, we should still not have the right to martyr, kill, or sell him to barbarians for our own good. But if souls were only mortal, this servitude might occur in entire races which are almost as dumb as cattle, and so could be kept in this stupidity for the advantage of their masters—at least to the extent that children can be reared not to advance beyond cattle. Now since the universal rules of justice are taught, and even atheists must accept them, it seems that the natural servants of men can be dealt with, provided, that is, any such servants are to be found. Even if such servitude is not to be endured in its full force among men, something similar and approaching it sometimes conforms to nature. To summarize, natural servitude applies to unintelligent men insofar as it is not restricted by the rules of piety.

The *fourth* natural society is the household, which is composed of all the societies mentioned above—some or all. Its purpose is man's daily needs.

The *fifth* natural society is civil society. If this is small, it is called a city; a province is a society of different cities, and a kingdom or a great dominion is a society of different provinces—all to achieve happiness or to be secure in it. The members of a civil society sometimes live together in a city, sometimes spread out over the land. Its purpose is temporal welfare.

The *sixth* natural society is the church of God, which would probably have existed among men even without revelation and have been preserved by pious and holy men. Its purpose is eternal happiness. No one need wonder that I call it a natural society, since there is a natural religion and a desire for immortality implanted within us. This society of the saints is catholic or universal and binds the entire human race together. If a revelation is added, this bond is not torn apart but merely strengthened by it.

A Classification of Societies or Communities

Every society is *equal* or *unequal*. It is equal when one has as much power in it as another, unequal when one rules over another.

Every society is either unlimited or limited. An unlimited society concerns the whole life and the common good. A limited society concerns certain purposes, for example, trade and commerce, navigation, warfare, and travel.

An unlimited equal society exists between true friends. Particularly does such a society exist between man and wife, between parents and grown children, between masters and freedmen, and in general between all intelligent men who have an adequate acquaintance with each other.

An unlimited unequal society exists between rulers and their subjects. Such rule occurs for the sake either of improvement or of conservation. If for the sake of improvement, it really takes place between parents and children, and also between us and those whom we accept in the place of children, or whom we so rear that they receive their welfare from us and are under our rule alone. It has no place between teacher and pupil, since the latter is subject to the former only in a certain degree or way, while we are here talking about an unlimited society which involves the whole life and welfare. Brutish men are grown children. But if such rule is for the sake of conservation, it exists between master and servant and consists in the master assuring the servant's welfare, while the servant submits to the master's rule.

All these societies are simple or composite, and also between few or many men. Hence all unlimited societies or communities [Lebensgesellschaften] can be reduced to certain points, namely, to education and instruction, rule and obedience, friendship and co-operation, etc.

To the extent that they have been reared, children already owe obedience as far as their powers permit, and, as they grow in understanding, they owe friendship and assistance to the master as well, even though their education is not completed.

Man and wife are bound by nature to friendship and mutual aid [Lebenshülfe] in a brotherly way. Similarly parents and children, and also relatives and people in a community, must have an understanding of each other, for to friendship belongs understanding.

One who is himself being educated may educate, and one who is ruled may at the same time rule. But in this case there must be subordination.

All unlimited societies do indeed aim at welfare, but they cannot always achieve it. Hence more and more societies have had to unite and build greater and stronger societies. Thus households, clans, villages, monasteries, orders, cities, provinces, and finally the whole human race, which also constitutes a community under the rule of God.

If everything in the world were arranged in the most perfect way, then, first of all, parents, children, and relatives would be the best of friends, and whole families would have chosen an art of living, would have arranged all that they have to this end, would abide in it and continue to perfect themselves in their art and direct their children to the same end. They would marry people of the same calling in order to be united through education from their parents. These clans would make up guilds or castes out of which cities would arise; these would enter into provinces, and all countries, finally, would stand under the church of God.

45

ON THE CORRECTION OF METAPHYSICS AND THE CONCEPT OF SUBSTANCE

Acta eruditorum, March, 1694

Leibniz's increasing inclination to publish his philosophical conclusions is shown in this brief article inserted in the Leipzig scholarly journal. In it he urges greater exactness in metaphysics and distinguishes his conception of active force from the ambiguous Scholastic principle of power. The article led to a correspondence with John Christopher Sturm on the problem of substance, of which No. 53, On Nature Itself, was one result.

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[G., IV, 468-70]

I find that most people who take pleasure in the mathematical sciences shrink away from metaphysics, because they find light in the former but darkness in the latter. The most important reason for this, I believe, is that general concepts which are thought to be very well known to everyone have become ambiguous and obscure through the carelessness and changeableness of human thinking and that the definitions commonly given of these concepts are not even nominal definitions and in fact explain nothing. And there is no doubt that this evil has spread to other fields subordinate to this primary and architectonic discipline. So, instead of clear definitions, we make trivial distinctions, and, in place of truly universal axioms, we set up limited rules [regulae topicae] which are more frequently broken by exceptions than supported by examples. Yet by a sort of necessity men continue to use metaphysical terms and, flattering themselves, believe that they understand the words they have learned to say. It is obvious that the true and fruitful concepts, not only of substance, but of cause, action, relation, similarity, and many other general terms as well, are hidden from popular understanding. No one should be astonished, therefore, that this regal science, which goes by the name of "first philosophy," and which Aristotle called desired or sought-after [ζητουμένη], has hitherto remained to be sought. Plato, of course, studies the force of concepts throughout his dialogues, and Aristotle does the same in the books which are commonly called the *Metaphysics*, but it does not seem that much was accomplished. The later Platonists lapsed into uttering omens, and the Aristotelians, especially the Scholastics, cared more about asking questions than about answering them. Some distinguished men in our own times have also set their minds on metaphysics, but so far without great success. It cannot be denied that Descartes has contributed some admirable things. Above all, he both rightly restored the study of Plato by leading the mind away from the senses and thereupon also added to it the doubts of the Academy. But he missed the mark because of a certain wavering or a license in making assertions and failed to distinguish the certain from the uncertain. And so he absurdly put the nature of corporeal substance in extension. Nor did he have any sound understanding of the union of soul and body. The cause of these errors was a failure to understand the nature of substance in general. For he proceeded to the solution of the most serious questions in a kind of leap, without having explained the concepts involved. Thus the failure of his *Meditations on Metaphysics* to achieve certainty is nowhere more apparent than in the writing in which, urged by Mersenne and others, he tried in vain to clothe them in mathematical dress.[86] I know that other men as well, of outstanding insight, have touched upon metaphysics and thought profoundly about some matters, but they have enveloped them in such darkness that they seem to have used divination rather than demonstrations. Yet it seems to me that light and certainty are more needed in metaphysics than in mathematics itself, because mathematical matters carry their own tests and verification with them, this being the strongest reason for success is mathematics. But in metaphysics we lack this advantage entirely. And so a certain distinctive order of procedure is necessary, which, like a thread in a labyrinth, will serve us, no less than the method of Euclid, to analyze our questions in the form of a calculus, yet nonetheless preserving the clarity which should never be lacking from popular speech.

The importance of these matters will be particularly apparent from the concept of substance which I offer. This is so fruitful that there follow from it primary truths, even about God and minds and the nature of bodies—truths heretofore known in part though hardly demonstrated, and unknown in part, but of the greatest utility for the future in the other sciences. To give a foretaste of this, I will say for the present that the concept of *forces* or *powers,* which the Germans call *Kraft* and the French *la force*, and for whose explanation I have set up a distinct science of *dynamics,* brings the strongest light to bear upon our understanding of the true concept of *substance*. Active force differs from the mere power familiar to the Schools, for the active power or faculty of the Scholastics is nothing but a close [*propinqua*] possibility of acting, which needs an external excitation or a stimulus, as it were, to be transferred into action. Active force, in contrast, contains a certain action or entelechy and is thus midway between the faculty of acting and the action itself and involves a conatus. It is thus carried into action by itself and needs no help but only the removal of an impediment.[87] This can be illustrated by the example of a heavy hanging body which strains at the rope which holds it or by a bent bow. For though gravity and elasticity can and ought to be explained mechanically by the motion of the ether, the ultimate reason for motion in matter is nevertheless the force impressed upon it in creation, which inheres in every body but is variously limited and restrained in nature through the impact of bodies upon each other. I say that this power of acting inheres in all substance and that some action always arises from it, so that the corporeal substance itself does not, any more than spiritual substance, ever cease to act. This seems not to have been perceived clearly by those who have found the essence of bodies to be in extension, alone or together with the addition of impenetrability, and who seem to conceive of bodies as absolutely at rest. It will be apparent from our meditations that one created substance receives from another created substance, not the force of acting itself, but only the limits and the determination of its own pre-existent striving or power of action. Not to speak now of other matters, I shall leave the solution of the difficult problem of the mutual action of substances upon each other for the future.[88]

46

SPECIMEN DYNAMICUM

1695

While in Italy Leibniz had written an extensive Dynamics (GM., VI, 281-514) which summarized his criticism of Descartes's physical principles and at the same time supplemented what he regarded as an incompleteness in Newton's hypotheses. The manuscript of this work he left at Florence with the Baron Bodenhausen, tutor of the sons of the Duke of Tuscany, with the intention of publishing it after it had undergone the criticism of his friends (see his letter to L'Hospital, January 15, 1696 [GM., II, 305-11]). The present work is a summary of this longer one, made in response to a general demand for his new ideas. Part I was printed in the Acta eruditorum in April, 1695; the second part remained unpublished and was found by Gerhardt among the Hanover manuscripts. The two parts together comprise a mature statement of Leibniz's theory of dynamics.

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SPECIMEN DYNAMICUM; IN BEHALF OF THE ADMIRATION OF LAWS OF NATURE CONCERNING CORPOREAL FORCES, THE DISCOVERY OF THEIR MUTUAL ACTIONS, AND THEIR REDUCTION TO THEIR CAUSES

[GM., VI, 234-54]

Part I

Since we first mentioned a new science of dynamics, which was still to be founded, many prominent men in various places have asked for a fuller explanation of its teachings. But as we have not yet found leisure to write a book, we shall here set down some things which may cast some light on it—light which will be returned to us with interest if we succeed in eliciting the opinions of men who combine force of insight with distinction of style. We confess that their judgment will be most welcome and, we hope, useful in advancing the perfection of the work.

We have suggested elsewhere that there is something besides extension in corporeal things; indeed, that there is something prior to extension, namely, a natural force everywhere implanted by the Author of nature—a force which does not consist merely in a simple faculty such as that with which the Scholastics seem to have contented themselves but which is provided besides with a striving or effort [conatus seu nisus] which has its full effect unless impeded by a contrary striving.[89] This nisus sometimes appears to the senses, and is in my opinion to be understood, on rational grounds, as present everywhere in matter, even where it does not appear to sense. But if we cannot ascribe it to God by some miracle, it is certainly necessary that this force be produced by him within bodies themselves.[90] Indeed, it must constitute the inmost nature of the body, since it is the character of substance to act, and extension means only the continuation or the diffusion of a striving and counter-striving already presupposed by it, i.e., the diffusion of a resisting substance. So far is extension itself from comprising substance!

It is beside the point here that all corporeal action arises from motion and that motion itself comes only from other motion already existing in the body or impressed upon it from without. For, like time, motion taken in an exact sense never exists, because a whole does not exist if it has no coexisting parts. Thus there is nothing real in motion itself except that momentaneous state which must consist of a force striving toward change. Whatever there is in corporeal nature besides the object of geometry, or extension, must be reduced to this force. This reasoning does justice, at last, both to truth and to the teachings of the ancients. Our age has already saved from contempt the corpuscles of Democritus, the ideas of Plato, and the tranquillity of the Stoics which arises from the best possible connection [*nexus*] of things; now we shall reduce the Peripatetic tradition of forms or entelechies, which has rightly seemed enigmatic and scarcely understood by its authors themselves, to intelligible concepts. Thus we believe that this philosophy, accepted for so many centuries, must not be discarded but be explained in a way that makes it consistent within itself (where this is possible) and clarifies and amplifies it with new truths.

This method of study seems to me best suited both for the wisdom of the teacher and for the advancement of the learners; we must guard against being more eager to destroy than to construct, and against being tossed about uncertainly, as if by the wind, among the perpetually changing teachings put forth by certain freethinkers. Then, after it has curbed the passion of sects, which is stimulated by the vain lust for novelty, mankind will at length advance with firm steps to ultimate principles in philosophy no less than in mathematics. For if we overlook entirely the harsher things which they say against others, the writings of outstanding men, both ancient and modern, usually contain many true and good things which deserve to be collected and arranged in the public treasury of knowledge. Would that men might choose to do this rather than to waste their time with criticisms that serve only to satisfy their own vanity. Indeed, though fortune has so favored me with the discovery of certain new things of my own that friends often urge me to think only about these, I nevertheless find pleasure in the views of others and appraise each according to its own worth, however this may vary. This may be because I have learned in my widespread activities not to despise anything. But now let us get back on the road.

Active force, which may well be called *power*, as it is by some, is of two kinds. The first is *primitive* force, which is in all corporeal substance as such, since I believe that a body entirely at rest is contrary to the nature of things. The second is derivative force, which is exercised in various ways through a limitation of primitive force resulting from the conflict of bodies with each other. Primitive force, which is nothing but the first entelechy, corresponds to the soul or substantial form, but for this very reason it relates only to general causes which cannot suffice to explain phenomena. Therefore I agree with those who deny that forms are to be used in investigating the specific and special causes of sensible things.[91] This I must emphasize to make it clear that, in restoring to the forms their proper function of revealing the sources of things to us, I am not trying to return to the word battles of the more popular Scholastics. A knowledge of forms is necessary, meanwhile, for philosophizing rightly, and no one can claim to have grasped the nature of body adequately unless he has paid some attention to such things and has come to understand that the crude concept of a corporeal substance which depends only on sensory imagery and has recently been carelessly introduced by an abuse of the corpuscular philosophy (which is excellent and most true in itself) is imperfect, not to say false.[92] This can also be shown by considering that such a concept of body does not exclude cessation or rest from matter and cannot provide reasons for the laws of nature which apply to derivative force.

Passive force is likewise of two kinds—primitive and derivative. The primitive force of suffering or of resisting constitutes the very thing which the Scholastics call materia prima, if rightly interpreted. It brings it about, namely, that one body is not penetrated by another but opposes an obstacle to it and is at the same time possessed of a kind of laziness, so to speak, or a repugnance to motion, and so does not allow itself to be set in motion without somewhat breaking the force of the body acting upon it. Hence the derivative force of suffering thereafter shows itself in various ways in secondary matter.[93] But setting aside these general and primary considerations, and having established the fact that every body acts by virtue of its form and suffers or resists by virtue of its matter, we must now proceed to the doctrine of derivative forces and resistances and discuss the question of how bodies prevail over or resist each other in various ways by their varied impulses. For to these derivative forces apply the laws of action, which are not only known by reason but also verified by sense itself through phenomena.

Here, therefore, we understand by derivative force, or the force by which bodies actually act and are acted upon by each other, only that force which is connected with motion (local motion, that is) and which in turn tends to produce further local motion. For we admit that all other material phenomena can be explained through local motion. Motion is the continuous change of place and thus requires time. But as the moving body has its motion in time, so it has a velocity at every moment of time, a velocity which is the greater in the degree that more space is passed through in less expenditure of time. This velocity along with direction is called conatus. Impetus, however, consists in the product of the mass [molis][94] of the body by its velocity, and so its quantity is that which Cartesians usually call the quantity of motion, that is, the momentaneous quantity, although, speaking more accurately, the quantity of motion, having an existence in time, is an integral of the impetuses (whether equal or unequal) existing in the moving body through a given interval of time. In our debate with the Cartesians, however, we have followed their way of speaking. Yet in the scientific use of terms, we may conveniently distinguish an increase which has already taken place, or one still to come, from one which is now occurring, designating this latter as the increment or element of the increase; or we can distinguish the falling of a body at the present moment from the fall which has already taken place which it increases. So we can also distinguish the present or instantaneous element of motion from the motion extended through time and call it "motion." Then what is popularly called motion would be called quantity of motion. But, although we can readily comply with any accepted terminology after its meaning is established, we must be careful about terms until this is done, in order not to be misled by their ambiguity.[95]

Furthermore, just as the calculation of motion carried out through time is integrated from an infinite number of impetuses, so in turn the impetus itself (even though it is a momentaneous thing) arises from a succession of an infinite number of impacts on the same moving body; so it too contains a certain element from which it can arise only through infinite repetitions. Assume a tube AC rotating about a fixed center C with a definite uniform velocity and in the horizontal plane of this page (Fig. 29). Assume a ball B moving within the tube without any chain or impediment and hence beginning to move by centrifugal force. It is obvious that the beginning of the conatus of receding from the center (the conatus, namely, by which the ball B tends toward the end of the tube A) is infinitely small with respect to the impetus which it already has from the rotation or that by which the ball B tends from D to D' along with the tube itself, while retaining its distance from the center. But if the centrifugal impulsion proceeding from the rotation is continued for some time, there must arise in the ball, from its own progression, a certain complete centrifugal impetus D'B' comparable to the impetus of rotation DD'. Hence the nisus is obviously twofold, an elementary or infintely small one which I also call a solicitation, and one formed by the continuation or repetition of these elementary impulsions, that is, the impetus itself. But I do not mean that these mathematical entities are really found in nature as such but merely that they are means of making accurate calculations of an abstract mental kind.

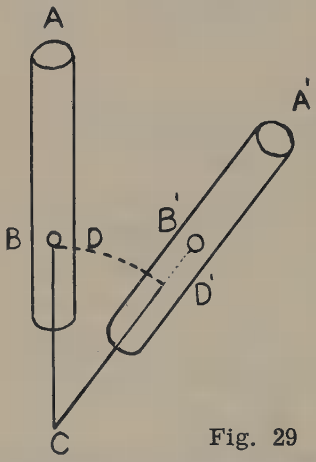

Fig. 29

Hence force is also of two kinds: the one elementary, which I also call *dead* force,[96] because motion does not yet exist in it but only a solicitation to motion, such as that of the ball in the tube or a stone in a sling even while it is still held by the string; the other is ordinary force combined with actual motion, which I call *living* force [*vis viva*]. An example of dead force is centrifugal force, and likewise the force of gravity or centripetal force; also the force with which a stretched elastic body begins to restore itself. But in impact, whether this arises from a heavy body which has been falling for some time, or from a bow which has been restoring itself for some time, or from some similar cause, the force is living and arises from an infinite number of continuous impressions of dead force. This is what Galileo meant when, in an enigmatic way, he called the force of impact infinite as compared with the simple impulsion of gravity. But even though impetus is always combined with living force, the two are nonetheless different, as we shall show below.

Living force in any aggregate of bodies can further be understood in two senses—namely, as *total* and *partial*. *Partial* force in turn is either relative or directive, that is, either proper to the parts themselves or common to all. *Relative* or *proper* force is that by which the bodies included in an aggregate can interact upon each other; *directive* or *common* force is that by which the aggregate can itself also act externally. I call this "directive" because the integral total force of direction is conserved on the basis of this partial force. Moreover, if it were assumed that the aggregate should suddenly become rigid by the cessation of the motion of the parts relative to each other, this alone would be left. Thus *absolute total force* is composed of relative and directive force taken together. But this can be understood better from the rules to be treated below.[97]

So far as we know, the ancients had a knowledge of dead force only, and it is this which is commonly called mechanics, which deals with the lever, the pulley, the inclined plane (applicable to the wedge and screw), the equilibrium of liquids, and similar matters concerned only with the primary conatus of bodies in itself, before they take on an impetus through action. Although the laws of dead force can be carried over, in a certain way, to living force, yet great caution is necessary, for it is at this point that those who confused force in general with the quantity resulting from the product of mass by velocity were misled because they saw that dead force is proportional to these factors. As we pointed out long ago, this happens for a special reason, namely, that when, for example, different heavy bodies fall, the descent itself or the quantities of space passed through in the descent are, at the very beginning of motion while they remain infinitely small or elementary, proportional to the velocities or to the conatuses of descent. But when some progress has been made and living force has developed, the acquired velocities are no longer proportional to the spaces already passed through in the descent but only to their elements.[98] Yet we have already shown, and will show more fully, that the force must be calculated in terms of these spaces themselves. Though he used another name, and, indeed, another concept, Galileo began the treatment of living force and was the first to explain how motion arises from the acceleration of heavy falling bodies. Descartes rightly distinguished between velocity and direction and also saw that in the collision of bodies that state results which least changes the prior conditions. But he did not rightly estimate this minimum change, since he changes either the direction alone or the velocity alone, while the whole change must be determined by the joint effect of both together. He failed to see how this was possible, however, because two such heterogeneous things did not seem to him to be capable of comparison or of simultaneous treatment—he being concerned with modalities rather than with realities in this connection;[99] not to speak of his other errors in his teachings on this problem.

Honoratius Fabri, Marcus Marci, John Alph. Borelli, Ignatius Baptista Pardies, Claude Deschales, and other most acute men have given us things that are not to be despised in the doctrine of motion, yet they have not avoided these capital errors.[100] So far as I know, Huygens, whose brilliant discoveries have enlightened our age, was also the first to arrive at the pure and transparent truth in this matter, and to free this doctrine from fallacies, by formulating certain rules which were published long ago. Almost the same rules were obtained by Wren, Wallis, and Mariotte, all excellent men in this field, though in differing measure.[101] But there is no unity of opinion about the causes; hence men who are outstanding in these studies do not always accept the same conclusions. It would seem, indeed, that the true foundations of this science have not yet been revealed. Not everyone has accepted the proposition which seems certain to me—that rebound or reflection results only from elastic force, that is, from the resistance offered by an internal motion. Nor has anyone before me explained the concept of forces itself, a matter which has always disturbed the Cartesians and others who could not understand that the sum of motion or of impetuses, which they take for the quantity of forces, can be different after collision than it was before, because they believed that such a change would change the quantity of forces as well.

While I was still a youth and followed Democritus, and Gassendi and Descartes, his disciples in this matter, in holding that the nature of body consists in inert mass alone, I brought out a small book entitled A Physical Hypothesis, in which I expounded a theory of both abstract and concrete motion. This writing seems to have pleased many distinguished men far more than its mediocrity deserved. There I set up the proposition that, assuming this conception of the nature of body to be true, every colliding body must give its conatus to the body receiving the blow or directly opposing it as such. For since it tries to proceed in the moment of impact, and thus to carry the opposing body with it, and (because of the indifference to motion and rest which I then held bodies to have) this conatus must have its full effect upon the opposing body unless it is impeded by a contrary conatus, and, indeed, even if it is impeded, since these diverse conatuses must be compounded with each other, it was obvious that no reason could be given why the colliding body should not attain the effect to which it strives, or why the opposing body should not receive the full conatus of the colliding one, so that the motion of the opposing body would be compounded of its own original motion and of that newly received from the external conatus. From this I showed further that if the body is understood in mathematical terms only—magnitude, figure, position, and their change—and conatus is admitted only at the moment of impact itself, no use being made of metaphysical notions such as active power in form, or of passive power and resistance to motion in matter, if therefore it is necessary to determine the outcome of the collision solely by the geometric composition of conatuses, as I have explained; then it must follow that the conatus of even the smallest colliding body must be transmitted to even the largest receiving body, and thus that the largest body at rest will be carried away by a colliding body, no matter how small, without any retardation of its motion, since such a notion of matter involves no resistance to motion but rather indifference to it. Thus it would be no more difficult to move a large body than a small one, and hence there would be action without reaction, and no estimation of power would be possible, since anything could be accomplished by anything.[102] Since this and many other matters of the same kind are contrary to the order of things, and in conflict with the principles of a true metaphysics, I believed at that time (and, indeed, rightly) that in this construction of the system the most wise Author of things had particularly avoided these things which would have followed per se from the bare laws of motion derived from pure geometry.

Later, however, after I had examined everything more thoroughly, I saw wherein the systematic explanation of things consists and discovered that my earlier hypothesis about the definition of a body was incomplete. In this very fact, along with other arguments, I found a proof that something more than magnitude and impenetrability must be assumed in body, from which an interpretation of forces may arise. By adding the metaphysical laws of this factor to the laws of extension, there arise those rules of motion which I should call systematic—namely, that all change occurs gradually, that every action involves a reaction, that no new force is produced without diminishing the earlier force, so that a body which carries another with it is retarded by the body carried away, and that there is neither more nor less power in the effect than in the cause. Since this law is not derived from the concept of mass, it must follow from something else which is in bodies, namely, from force itself, which always preserves the same quantity even though it is used by different bodies. I concluded, therefore, that, besides purely mathematical principles subject to the imagination, there must be admitted certain metaphysical principles perceptible only by the mind and that a certain higher and, so to speak, formal principle must be added to that of material mass, since all the truths about corporeal things cannot be derived from logical and geometrical axioms alone, namely, those of great and small, whole and part, figure and situation, but that there must be added those of cause and effect, action and passion, in order to give a reasonable account of the order of things. Whether we call this principle form, entelechy, or force does not matter provided that we remember that it can be explained intelligibly only through the concept of forces.

I cannot agree with certain prominent men today, however, who see the inadequacy of the popular concept of matter, but call in God *ex machina* and remove all force of action from things themselves, as is done in a work on the Mosaic Philosophy, as Fludd called it. For although I should agree that they have shown clearly that there can be no distinct influx of one created substance into another, if the matter is taken in metaphysical rigor, and I also admit freely that all things arise by a continuous creation from God, yet I think that there is no natural truth in things for which we must find the reason in the divine action or will but that God has always put into things themselves some properties by which all their predicates can be explained. Certainly God has created not only bodies but also souls, to which the primitive entelechies correspond. But I shall demonstrate these matters elsewhere by following out their proper reasons more thoroughly.

Meanwhile, even though I hold that an active principle which is superior to material concepts and, so to speak, vital exists everywhere in bodies, I do not agree with Henry More and other men distinguished for piety and spirit, who make use of some Archeus—I know not what—or hylarchic principle, even to explain phenomena; as if there are some things in nature which cannot be explained mechanically and as if those who undertake a mechanical explanation aim to deny incorporeal beings, with a suspicion of impiety—or as if it were necessary to appoint intelligences for the revolving starry orbs as Aristotle did, or to say that the elements are driven upward and downward by their own form, a teaching that is certainly as naïve as it is fruitless.[103] With these things, I say, I do not agree, and this philosophy pleases me no more than the theology of those who believed so firmly that Jupiter thunders and snows that they even branded those who sought after the specific causes of these things with the crime of atheism. In my judgment the best answer, which satisifies piety and science alike, is to acknowledge that all phenomena are indeed to be explained by mechanical efficient causes but that these mechanical laws are themselves to be derived in general from higher reasons and that we thus use a higher efficient cause only to establish the general and remote principles. Once this is established, we need not admit entelechies any more than we admit superfluous faculties or inexplicable sympathies, as long as we are dealing only with the immediate and particular efficient causes of natural things. For the first and most universal efficient cause must not enter into special problems, aside from our viewing the ends to which the Divine Wisdom adhered in ordering things in such a way, lest we neglect any opportunity to sing the most beautiful hymns in his praise.

In fact, as I have shown by the remarkable example of the principles of optics, the celebrated Molyneux having warmly approved my interpretation in his Dioptrics,[104] final causes may be introduced with great fruitfulness even into the special problems of physics, not merely to increase our admiration for the most beautiful works of the supreme Author, but also to help us make predictions by means of them which would not be as apparent, except perhaps hypothetically, through the use of efficient causes. Philosophers have in the past perhaps not sufficiently observed this advantage of final causes. It must be maintained in general that all existent facts can be explained in two ways—through a kingdom of power or efficient causes and through a kingdom of wisdom or final causes; that God regulates bodies as machines in an architectural manner according to laws of magnitude or of mathematics but does so for the benefit of souls and that he rules over souls, on the other hand, which are capable of wisdom, as over citizens and members of the same society with himself, in the manner of a prince or indeed of a father, ruling to his own glory according to the laws of goodness or of morality. Thus these two kingdoms everywhere permeate each other, yet their laws are never confused and never disturbed, so that the maximum in the kingdom of power, and the best in the kingdom of wisdom, take place together. But here we have undertaken to set up the general rules for effective forces, which we can then use in explaining special efficient causes.

Next I arrived at a true estimation of forces and at exactly the same one, moreover, by widely different ways. One was a priori, based on the most simple consideration of space, time, and action; this I shall explain elsewhere. The other was a posteriori, by calculating force by the effect it produces in expending itself. For by effect I mean here not any effect whatever but that for which force is expended or consumed and which may therefore be called violent. The force which a heavy body exercises in moving along a perfectly horizontal plane is not of this kind, because, however far such an effect is prolonged, it always retains the same force, and though we use the same principle in calculating this effect also, which we may call harmless, we now exclude it from consideration. Moreover, I choose that particular form of violent force which is most capable of homegeneity or of division into similar and equal parts, such as is found in the ascent of a body endowed with gravity. For the elevation of a heavy body to 2 or 3 feet is exactly double or triple the elevation of the same weight to 1 foot. Hence the elevation of a body twice as heavy to 3 feet is exactly six times as great as the elevation of a simple body for 1 foot, assuming of course, for the sake of exposition, that heavy bodies have the same weight at different heights, for, though this is not true in fact, the error will be imperceptible. Homogeneity is not so easily established in elastic bodies. Therefore, since I wanted to compare bodies with different masses and different velocities, I saw of course that if body A is a simple unit and body B twice as large, but the velocity is equal in the two cases, the force of the former must be a simple unit and that of the latter double, since whatever is assumed to occur once in the former must be taken to occur exactly twice in the latter. For in B the matter is twice the equal and equivalent of A, and nothing more. But if the bodies A and C are equal, but the velocity of A is simple and that of C twice as large, I saw that the properties of A would not be exactly doubled in C, since, though the velocity is doubled, the body is not also. I saw that an error had been committed here by those who think that force is itself doubled merely by the doubling of a property. I have already observed and explained long ago that we do not yet have the true art of calculating in spite of the many "Elements of Universal Mathematics" that have been written and that this art consists in arriving at length at homogeneous things, that is, at an accurate and complete duplication of things as well as their properties. No better or more illuminating example of this method can be given than the one shown in this argument.[105]

In order to obtain these results, therefore, I considered whether these two bodies, equal in magnitude but different in velocity, could produce any effects that were both equipollent with their causes and homogeneous with each other. In this way things which cannot easily be compared directly can at least be compared accurately through their effects. I assumed that an effect must be equal to its cause if the entire force is expended or consumed in producing it; the length of time taken to produce the effect does not matter here. Assume therefore that bodies A and C are equally heavy and that their force is converted into an ascent, as happens if they are understood to be at the ends of vertical pendulums PA and EC at the moment at which they receive the given velocities, A's velocity being simple and C's twice as large (Fig. 30). But the demonstrations of Galileo and others have established the fact that if body $A,$ with a velocity of 1, ascends to a maximum height A_2H of 1 foot over the horizontal, the body $C,$ with a velocity of 2, will ascend to a height C_2R of 4 feet. Hence it follows that a heavy body whose velocity is double that of another has a force four times that of the other, since the expenditure of all its force can accom-

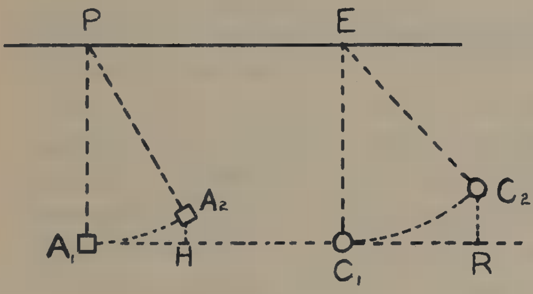

Fig. 30

plish exactly four times as much. In lifting 1 pound (that is, itself) 4 feet, it lifts 1 pound 1 foot exactly four times. In the same way we can conclude in general that the forces of equal bodies are proportional to the squares of their velocities and that the forces of bodies in general are proportional, compositely, to their simple masses and the squares of their velocities.

I have confirmed the same thing by reducing the contrary opinion, which is popularly accepted, especially among the Cartesians, to an absurdity, namely, to perpetual motion. According to this opinion, forces are believed to be proportional to the products of their masses and velocities. I have also sometimes used this method to give an a posteriori definition of *two states unequal in force* and at the same time to provide a sure criterion for distinguishing the greater from the smaller. Since no perpetual mechanical motion can arise, or no effect greater than its cause when one is substituted for the other, the two states are not in the least equipollent, but that which was substituted for the other was more powerful, since it brought something greater to pass. I assume it to be certain, however, that nature never substitutes for forces something unequal to them but that the whole effect is always equal to the full cause. Thus we, in turn, can safely substitute things which are equal to these forces in our reckoning, freely assuming that this is just as if we actually carried out the substitution itself, without any fear[106] of perpetual mechanical motion. If it were true, as men are commonly persuaded, that a heavy body A of magnitude 2 (for this is now our assumption) and velocity 1, and a heavy body C with magnitude 1 and velocity 2, are equipollent to each other, we should be able to substitute one for the other with impunity—a thing which is not true. For let us assume that A, with magnitude 2, has acquired a velocity of 1 in its descent A_2A_1 from the height A_2H, which is 1 foot;[107] and then let us substitute for it, as it exists on the level of A_1, the weight C (which they claim is equipollent to it) with magnitude 1 and velocity 2, which ascends to C_2, a height of 4 feet. Thus, merely by the descent of a 2-pound weight *A* from the height of 1 foot A_2H, we have, by substituting its supposed equipollential, brought about a rise of 1 pound to 4 feet, which is double the former effect. Therefore we have gained this much force or achieved a perpetual mechanical motion, which is absurd. Whether we can actually accomplish this substitution through the laws of motion is irrelevant, for equipollents can safely be substituted for each other in the mind. But I have also thought out various methods by which we can actually carry out, as nearly as we wish, the transfer of the whole force of the body *A* to the body *C*, previously at rest, so that *C* alone is placed in motion while *A* is brought to rest. The result should be that to the double weight of velocity 1 there would succeed a 1-pound weight with velocity 2, if these are equipollent, and, as we have shown, an absurdity arises from this. These considerations are not worthless, nor are they merely verbal, for they have important applications in the comparison of machines and motions. For if enough force is received, from water power, animals, or some other cause, to keep a heavy body of 100 pounds in constant motion, so that it can complete a horizontal circle 30 feet in diameter in a fourth of a minute, and someone claims that a weight twice as large put in its place would complete half the circle in the same time, and with less expenditure of power, and claims that this means a profit to you, you may know that you are being deceived and are losing half of the force. But, having now put these errors to flight, we will propound the true and genuinely admirable laws of nature a little more distinctly in the second part of this study.[108]

Part II

The fact that the nature of body, and indeed of substance in general, is not well enough understood has resulted, as we have already suggested, in outstanding philosophers of our time locating the notion of body in extension alone and being driven therefore to take refuge in God to explain the union between soul and body and, in fact, the communication between bodies themselves. For it must be admitted that it is impossible for mere extension, which involves only geometric concepts, to be capable of action and passion. So only one possibility seemed to remain for them—that, when man thinks and starts to move his arm, God, as if by an original agreement, moves his arm for him; and, conversely, that, when there is a motion in the blood and animal spirits, God excites a perception in the soul. But such views are foreign to the true method of philosophizing and should have shown their authors that they were depending on a false principle and had not set up a correct concept of substance, since such consequences followed from it. We show, therefore, that there is in every substance a force of action and that, if it is created substance, there is also a force of suffering. We show too that the concept of extension is not complete in itself but requires a relation to something which is extended, and whose diffusion or continuous repetition it implies, and therefore that it presupposes also a bodily substance which involves the power to act and resist, and which exists everywhere as corporeal mass, the diffusion of which is contained in extension. Sometime we shall use this view to throw new light on the union of body and soul.[109] But now we must show that there follow from it wonderful and most useful practical theorems which apply to dynamics, the science which deals particularly with the laws of corporeal forces.

First of all, we must recognize that force is something absolutely real even in created substances but that space, time, and motion are of the nature of relations [de ente rationis][110] and are not true and real per se but only insofar as they involve the divine attributes such as immensity, eternity, and activity or the force of created substances. Hence it follows at once that there is no vacuum in space and time; that motion apart from force (or insofar as it involves only a consideration of the geometric concepts of magnitude, figure, and their variations) is in fact nothing but change of situation; and thus that motion insofar as it is phenomenal consists in a mere relationship. Descartes, too, acknowledged this when he defined translation from the position of one body to the position of another. But he forgot his definition when he deduced its consequences and set up rules of motion as if motion were something real and absolute. Therefore, we must hold that, if any number of bodies are in motion, we cannot determine from the phenomena which of them are in absolute determinate motion or rest; rest can be attributed to any one of them you may choose, and yet the same phenomena will be produced. It follows therefore (Descartes did not notice this) that the equivalence of hypotheses is not changed by the impact of bodies upon each other and that such rules of motion must be set up that the relative nature of motion is saved, that is, so that the phenomena resulting from the collision provide no basis for determining where there was rest or determinate absolute motion before the collision. Thus the rule of Descartes, which claims that a body at rest can in no way be driven from its place by a smaller body, hardly squares with the truth. He has other rules of this kind, too, than which nothing is further from the truth. It also follows from the relative nature of motion that the action of bodies upon each other or their force of percussion is the same, provided they approach each other at the same velocity. That is to say, if the given phenomena appear the same, whatever may be the true hypothesis or however we may ascribe motion or rest to them, the same result will be produced in the unknown or the resulting phenomena, even with respect to the action of bodies upon each other. This conforms to our experience; we will feel the same pain whether our hand strikes a stone which is at rest, suspended from a thread, if you will, or the stone strikes our hand at rest with the same velocity. Meanwhile we speak as the situation demands, in whatever way provides the more fitting and simpler explanation of the phenomena, just as we make use of the motion of a primum mobile in the study of spheres and must use the Copernican hypothesis in planetary theory. Thus we already cause those violent arguments which have been carried on with so much energy, even by theologians, to disappear completely.[111] For even though force is something real and absolute, motion belongs to the class of relative phenomena, and truth is found not so much in phenomena as in their causes.

From our concepts of body and of forces there arises also this principle—that *whatever happens in substances must be understood to happen spontaneously and in an orderly way*. With this is connected the principle that *no change occurs through a leap*. If this is established, it follows also that *there can be no atoms*. That the force of this conclusion may be grasped, let us assume that bodies A and B collide, that A_1 comes to A_2 and B_1 to B_2, and that, colliding at A_2B_2, they are deflected from A_2 to A_3 and from B_2 to B_3 (Fig. 31). Assuming, then, that there are atoms, that is, bodies of maximum hardness and therefore inflexible, change would obviously occur through a leap or in a moment, for the direct motion becomes retrograde at the very moment of collision, unless we assume that the bodies rest instantaneously after the collision, that is, that they lose their force—a thing which, besides being absurd on other grounds, would still contain a change through a leap, namely, an instantaneous change from motion to rest without passing through intermediate degrees. We must thus recognize that if bodies A and B collide and come from A_1 and B_1 to the place of collision A_2B_2, they are there gradually compressed like two inflated balls, and approach each other more and more as the pressure is continuously increased; but that the motion is weakened by this very fact and the force of the conatus

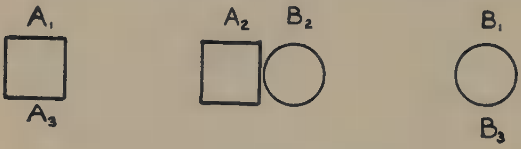

Fig. 31

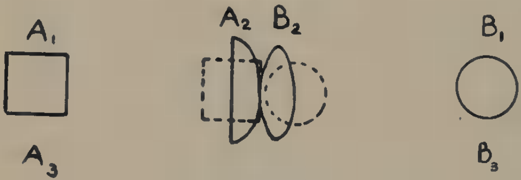

Fig. 32

carried over into the elasticity of the bodies, so that they then come entirely to rest (Fig. 32). Then, as the elasticity of the bodies restores itself, they rebound from each other in a retrograde motion beginning from rest and increasing continuously, at last regaining the same velocity with which they had approached each other, but in the opposite direction so that they regress and return to the positions A_3 and B_3, which coincide with A_1 and B_1 if the bodies are assumed equal and with equal velocities. From this it is now clear that no change occurs through a leap but only by a gradually diminished progression finally reduced to rest, after which regression begins. Just so, one figure is not made from another (an oval from a circle, for instance) except by innumerable intermediate figures, and nothing passes from one place to another or from one time to another except by passing through all the intermediate places or times. Thus rest, and much less a motion in the opposite direction, cannot come from motion except through all the intervening degrees of motion. This is of such great importance in nature that I wonder that it has been so little noticed. There follows also from these matters the view which Descartes attacked in his letters and which some great men are even now unwilling to admit—that all rebound arises from elasticity, and a reason is given for many brilliant experiments which show that a body is bent before it is propelled; Mariotte has shown this most beautifully. Finally, there follows also that most admirable principle of all—that there is no body, however small, which has no elasticity and is not thus permeated by a still subtler fluid; and thus that there are no elementary bodies, nor any most fluid matter, nor any solid globes of some second element, I know not what; but that analysis proceeds to the infinite.

It is also in agreement with this law of continuity, which excludes a leap from change, that the case of rest can be considered as a special case of motion, namely, the case of a disappearing or minimal motion, and that the case of equality can be held for a case of disappearing inequality. The consequence is that the laws of motion must be set up in such a way that particular rules are not necessary for equal and resting bodies, but that these arise from the rules for unequal and moving bodies as such. Or if we wish to formulate particular rules for rest and equality, we must be careful not to set up such rules as do not agree with a hypothesis which considers rest as the limit of motion, and equality as the smallest inequality. Otherwise we shall violate the harmony of things, and our rules will not agree with each other. I first published this new device for testing our own rules and those of others in the *Nouvelles de la république des lettres* for July, 1687, Article 8, and called it a general principle of order arising from the concept of the infinite and the continuous, adding to this the axiom that, as the data are ordered, the unknowns are also ordered [*datis ordinatis etiam quaesita sunt ordinata*]. I expressed the matter universally in this way—*if in a given series one value approaches another value continuously, and at length disappears into it, the results dependent on these values in the unknown series must also necessarily approach each other continuously and at length end in each other.* So in geometry, for example, the case of an ellipse continuously approaches that of a parabola as one focus remains fixed and the other is moved farther and farther away, until the ellipse goes over into a parabola when the focus is removed infinitely. Therefore all the rules for the ellipse must of necessity be verified in the parabola (understood as an ellipse whose second focus is at an infinite distance). Hence rays striking a parabola in parallel lines can be conceived as coming from the other focus or as tending toward it. Therefore, since the case in which the body *A* strikes *B* in motion can be varied continuously in the same way, so that as the motion of *A* remains constant, the motion of B can be assumed to be greater or smaller and at length to disappear into rest and then into increasing motion in the contrary direction, I maintain that the result of the collision when both are in motion, whether it be the result in *A* or in *B*, must continuously approach the result of the collision in the case when B is at rest, and must finally merge with it. So the case of rest in the given series as well as its results in the unknown series is the limit of the cases of directed motion, or the common limit of linear or continuous motion, and so, as it were, a special case of both. When I examined the Cartesian rules of motion by means of this touchstone, which I carried over from geometry into physics, it turned out that a kind of hiatus or leap was revealed which is contrary to the nature of things, for when the quantities involved were expressed graphically, the motion of B before collision in all its cases being taken for the abscissas, and the motion of B after collision as the unknown, for the ordinates, and a line was drawn through the ordinates according to their values by Descartes's rules, this line proved not to be one continuum but something with amazing gaps, with leaps of an absurd and unintelligible kind.[112] On that occasion I had also observed that the rules of the Reverend Father Malebranche did not meet this test in all respects, and, after weighing the matter again with his usual candor, that distinguished man admitted that this led him to change his rules, and he brought out a small book to this effect. Yet it must be admitted that he had not yet sufficiently mastered the use of this new device and has left things which even now do not yet fit together completely.[113]

From what has been said it also follows, remarkably, that every passion of a body is spontaneous or arises from an internal force, though upon an external occasion. But I mean by this the passion proper to it, which arises from percussion, or which remains the same whatever hypothesis may be chosen or to whatever body we may ascribe rest or motion. For since the percussion is the same regardless of what body the true motion belongs to, it follows that the effect of percussion will be equally distributed between both, and thus that both act equally in the collision, so that half of the effect comes from the action of one, the other half from the action of the other. And since half of the effect or passion is also in one and half in the other, it suffices to derive the passion which is in one from the action which is in it, so that we need no influence of one upon the other,[114] even though the action of one provides an occasion for the other to produce a change within itself. Certainly when *A* and *B* collide, the resistance of the bodies combined with elasticity causes them to be compressed through the percussion, and the compression is equal in both, whatever may be the hypothesis about their original motion. Experiments show this, too, if we let two inflated balls collide, whether both are in motion or one is at rest, and even if the one at rest is suspended from a string so that it can swing back with ease, for if the velocity of approach or relative velocity is always the same, the compression or elastic tension will be the same and will be equal in both. Then the balls *A* and *B* will restore themselves by force of the active elasticity compressed within them, repel each other, and burst apart as if driven by a bow, each being driven back from the other with equal force, and thus receding, not by force of the other, but by its own force. But what is true of inflated balls must be understood of every body insofar as it suffers in percussion. Repercussion and repulsion, namely, arise from elasticity within the body itself, or from the motion of an ethereal fluid matter which permeates it, and so from an internal force existing within it. But, as I have said, I mean the proper motion, belonging to the bodies, separate from the common motion, or motion which can be ascribed to their common center of gravity; hence their proper motion is to be thought of (in a hypothetical way) as if they were carried in a ship which has a motion common to their center of gravity, while they themselves move in such a way that the phenomena can be saved, both with regard to the composite motion common to the ship or their center and that proper to themselves.[115] It is also understood from what has been said that there is never an action of bodies without reaction and that both are equal to each other and in contrary directions.

Also, since only force and the effort arising from it at any moment exist (for, as we have explained above, motion never truly exists) and every effort tends in a straight line, it follows that all motion is in straight lines, or compounded of straight lines. Hence it not only follows that whatever moves in a curve strives always to proceed in a straight line tangent to it, but there also arises here, the true notion of firmness, which one would hardly expect. For if we assume that some one of those bodies which we call firm (although nothing is in fact absolutely firm or fluid but has a certain degree of firmness and fluidity, being called firm by us only out of a predominant regard for our senses)—if we assume one of these bodies to rotate about its center, its parts will strive to fly off on a tangent; indeed, they really begin to fly off. But, because this separation from each other disturbs the motion of the body surrounding them, they are thus repelled or crowded into each other again, as if there were a magnetic force in the center which attracts them, or as if there were a centripetal force in the parts themselves. The result is a rotation compounded of the rectilinear effort along the tangent and this centripetal impulse together. So all curvilinear motion arises as a continuous composition of rectilinear efforts with centripetal ones, and at the same time we understand that this crowding together by the surrounding bodies is the cause of all firmness. Otherwise it would be impossible for all curvilinear motion to be composed of mere rectilinear motions. This gives us another unexpected argument against atoms. Nothing more foreign to nature can be conceived, moreover, than to seek firmness in rest, for there is never any true rest in bodies, and nothing but rest can arise from rest. But though A and B may be at rest in relation to each other, if not actually, at least relatively (accurately speaking, however, this never occurs, for no body ever preserves exactly the same distance from another for any length of time, however small), and though whatever once rests will always be at rest unless a new cause is added yet it does not follow that, because B resists a striking body, it will also resist that which separates it from others, so that A would at once follow when the resistance of B is overcome or B is itself propelled. But if true attraction, which is not found in nature, were explained from a primitive firmness, or through rest or something similar, this would certainly follow. Firmness is therefore not to be explained except as made by the crowding together by the surrounding matter. For pressure alone does not adequately explain the problem, as if only the separation of B from A is prevented; it must be understood that they do in fact separate from each other but are again driven together by the surrounding matter, so that this conservation of their union is produced by the composition of two motions. Thus those who conceive of certain slabs or imperceptible layers in bodies, like two slabs of polished marble which fit together exactly, which it is difficult to separate because of the resistance of the surrounding matter, and who explain the firmness of two sensible bodies in this way, may indeed often be speaking the truth; but, since they presuppose some firmness in the slabs themselves, they have given no ultimate explanation of firmness. From these considerations it can be understood why I cannot support some of the philosophical opinions of certain great mathematicians on this matter, who admit empty space and seem not to shrink from the theory of attraction but also hold motion to be an absolute thing and claim to prove this from rotation and the centrifugal force arising from it. But, since rotation arises only from a composition of rectilinear motions, it follows that if the equipollence of hypotheses is saved in rectilinear motions, however they are assumed, it will also be saved in curvilinear motions.[116]

It can also be understood from what has been said that the motion common to a system of bodies does not change their actions among themselves, because the relative velocity with which they approach each other and so the force of collision with which they approach each other are not changed. There follow from this the outstanding experiments which Gassendi reported in his letters about a motion imparted by a moving body which is itself being translated; he did this to answer those who thought they could infer that the earth is at rest from the motion of projectiles. It is certain, however, that if people are being transported in a large ship (assumed to be closed, or at least so constructed that the passengers cannot observe external things), and the ship moves at a great velocity, yet smoothly and without acceleration, they will have no principle by which to discern whether the ship is at rest or in motion (on the basis, that is, of what is happening within the ship), even if they play ball or carry out other motions. This must be noted in support of those who believe in the Copernican theory, which they do not rightly understand. According to them, bodies projected from the earth into the air are caught up by the air which is turning with the earth, and so follow the motion of the earth, and likewise fall back to earth as if this were at rest. This view is rightly to be judged inadequate, since the most learned men who use the Copernican hypothesis think rather that whatever is on the surface of the earth moves with the earth, and, if it is shot by a bow or catapult, it carries with it the impetus impressed on it by the rotation of the earth, together with the impetus impressed by its projection. Hence, since its twofold motion is in part common with the earth, in part peculiar to its projection, it is not surprising that this common motion changes nothing. Meanwhile it must not be concealed that if projectiles can be driven so far, or the ship be conceived as so large and moving with so great a velocity that before the descent the earth or the ship will describe an arc perceptibly different from a straight line, a difference would be perceived, because then the motion of the earth or ship, being circular, would not remain common with the motion impressed on the missile by the ship or by the rotation of the earth, which was rectilinear. In the striving of heavy bodies toward a center, moreover, an external action is added which can produce a diversity of phenomena, no less than if there were a compass in the inclosed ship which pointed to the pole and which would certainly indicate a variation in the ship's direction. But, whenever the equipollence of hypotheses is involved, every factor contributing to the phenomena must be included. It is also understood from these matters that the composition of motions or the resolution of one motion into two or any number whatever can safely be used, even though, according to Wallis, one brilliant man has raised plausible doubts. For the matter certainly deserves to be proved and cannot be assumed to be known in itself, as many have done.

47

A NEW SYSTEM OF THE NATURE AND THE COMMUNICATION OF SUBSTANCES, AS WELL AS THE UNION BETWEEN THE SOUL AND THE BODY

Journal des savants, June 27, 1695

Leibniz's first published account of his metaphysical "system"[117] appeared in the well-established Paris journal to which he had contributed scientific articles since his Paris days. Since its contents are directly related to the writings and controversies on dynamics in which he had been involved, its emphasis is not theological, like that of the Discourse of 1686 (No. 35), but falls upon the problem of the individuality of created substance; the mind-body relation is treated by analogy to his analysis of the relationships of force in a compound material system.

The essay brought Leibniz's thinking to a focus, since it stimulated the first public discussion of his metaphysics as such, Foucher, Beauval, Bayle, and Lami soon publishing criticisms of it, to which Leibniz wrote careful replies. The "second explanation" made in reply to these critics is added as a supplement. The text is that of the published article, which Schmalenbach reproduces; G. gives a later revision. The paragraph numbers were added by Erdmann.

* * *

[Sch., I, 119-31 (G., IV, 477-87)]

1. It is some years ago that I conceived this system and began communicating with learned men about it, especially with one of the greatest theologians and philosophers of our time, who had been told about certain of my opinions by a person of the highest nobility and had found them very paradoxical.[118] After receiving my explanations, however, he retracted in the most generous and edifying way possible, and, after approving a part of my propositions, he withheld his censure of the others upon which he still did not agree with me. Since that time I have continued my meditations as occasions offered, so as to give to the public only well-examined opinions, and I have tried also to answer the criticisms raised against my essays on dynamics which have some connection with this. Since some eminent persons have asked to see my opinions more clearly developed, I have ventured upon these meditations, though they are not at all popular or suited to the enjoyment of all sorts of minds. I have decided upon this chiefly in order to profit by the criticisms of those who are informed on such matters, since it would be too burdensome to seek out and call to my aid individually those who would be disposed to give me instruction. This I shall always be pleased to receive, provided that the love of truth be shown in it rather than a passionate attachment for preconceived opinions.

2. Although I am one of those who have done much work in mathematics, I have constantly meditated on philosophy from my youth up, for it has always seemed to me that here, too, there is a way to establish something sound through clear demonstrations. I had penetrated deeply into the land of the Scholastics, when mathematics and modern authors made me withdraw from it while I was still young. Their beautiful ways of explaining nature mechanically charmed me, and with good reason I despised the method of those who use only forms or faculties of which nothing is understood. But later, after trying to explore the principles of mechanics itself in order to account for the laws of nature which we learn from experience, I perceived that

the sole consideration of *extended mass* was not enough but that it was necessary, in addition, to use the concept of *force,* which is fully intelligible, although it falls within the sphere of metaphysics. It seemed to me also that, though the opinion of those who transform or degrade beasts into pure machines seems possible, it goes beyond appearances and is even contrary to the order of things.

3. At first, after freeing myself from bondage to Aristotle, I accepted the void and the atoms, for it is these that best satisfy the imagination. But, in turning back to them after much thought, I perceived that it is impossible to find *the principles of a true unity* in matter alone or in what is merely passive, since everything in it is but a collection or aggregation of parts to infinity. Now a multitude can derive its reality only from the *true unities,* which have some other origin and are entirely different from points, for it is certain that the continuum cannot be compounded of points. To find these *real unities,* therefore, I was forced to have recourse to a formal atom, since a material being cannot be at the same time material and perfectly indivisible, or endowed with true unity.[119] It was thus necessary to restore and, as it were, to rehabilitate the *substantial forms* which are in such disrepute today, but in a way which makes them intelligible and separates their proper use from their previous abuse. I found then that their nature consists of force and that there follows from this something analogous to sense and appetite, so that we must think of them in terms similar to the concept which we have of *souls.* But just as the soul ought not to be used to explain the details of the economy of the animal's body, so I concluded that one ought not to use these forms to explain the particular problems of nature, though they are necessary to establish its true general principles. Aristotle calls them *first entelechies.* I call them, more intelligibly perhaps, *primitive forces,* which contain not only the *actuality* or the *completion* of possibility but an original *activity* as well.[120]

4. I saw that these forms and these souls must be indivisible, just as is our mind; in fact, I remembered that this was the opinion of St.

Thomas with regard to the souls of beasts.[121] But this truth revived the great difficulties about the origin and duration of souls and forms. For since every substance[122] which has a true unity can begin and end only by a miracle, it follows that souls can begin only by creation and end only by annihilation. So I was obliged to recognize that, except for the souls which God still expressly wills to create, the forms which constitute substances have been created with the world and that they will subsist always. Moreover, certain Scholastics like Albert the Great and John Bacon had glimpsed a part of the truth about the origin of these forms. Nor should this opinion appear extraordinary, since we are merely ascribing to the forms the duration which the Gassendists grant to their atoms.

5. I concluded, nevertheless, that we must not mix up indifferently, or confuse, minds or rational souls with other forms or souls, for they are of a superior order and have incomparably more perfection than have the forms which are sunk in matter, which I believe are found everywhere. For, in comparison with these, minds or rational souls are as little gods made in the image of God and having in them some ray of the light of the Divinity. This is why God governs minds as a prince governs his subjects or indeed as a father cares for his children, while he deals with other substances, instead, as an engineer handles his machines. Minds thus have special laws which place them beyond the revolutions of matter,[123] and one can say that all the rest is made only for them, these revolutions themselves being adapted to the happiness of the good and the punishment of the evil.

6. To return to ordinary forms, however, or to material souls,[124] this duration which we must ascribe to them instead of that which was attributed to the atoms could lead us to doubt whether they do not pass from body to body. This would be *metempsychosis,* somewhat like the transmission of motion and of species in which some philosophers have believed.[125] But such a fancy is far from the nature of things. There is no such transfer; at this point the *transformations* of Swammerdam, Malpighi, and Leeuwenhoek, the best observers of our times, have come to my aid and led me to admit the more readily that

animals and all other organized substances do not at all begin when we believe them to and that their apparent generation is merely a development and a form of augmentation. I have noticed, too, that the author of the Recherche de la vérité and Mr. Regis, Mr. Hartsoeker, and other able men have held opinions not far removed from this.[126]

7. The greatest question still remained, however: What becomes of the souls or forms at the death of the animal or at the destruction of the individual unit of organized substance? This question is the more difficult, inasmuch as it hardly seems reasonable that souls should remain, useless in a chaos of confused matter. This led me at length to conclude that there is only one reasonable view to take—that of the conservation not only of the soul but also of the animal itself and its organic machine, even though the destruction of its grosser parts may have reduced this machine to a size so small that it escapes our senses just as it did before birth. Moreover, no one can mark exactly the true time of death, which may for a long time be taken to be a simple suspension of observable actions and in the last analysis is never anything but this in the simple animals. Witness the resuscitation of flies which have been drowned and then buried under powdered chalk, and a number of similar examples which suffice to show that there would be other resuscitations, in cases much further gone, if men were in a position to restore the mechanism. It seems that the great Democritus spoke of something approaching this, extreme atomist though he was, though Pliny laughed at his opinion.[127] It is natural, then, that animals which have always been living and organized (as people of great penetration are beginning to recognize) will also always remain so. And since an animal has thus no first birth or entirely new generation, it follows that there will be no final extinction or complete death, in a strict metaphysical sense, and that, as a result, there is no transmigration of souls but only a transformation of the same animal, as its organs are differently folded and are more or less developed.

8. Rational souls, however, follow much more elevated laws and are exempt from everything which might make them lose the quality of citizens of the society of minds, since God has provided so well that no changes in matter can make them lose the moral qualities of their personality. And one can say that everything tends to the perfection not merely of the universe in general but also of these created beings in particular, which are destined for so high a degree of happiness that the universe itself is concerned in it by virtue of the divine goodness which is communicated to each being to the extent which the sovereign wisdom can permit.

9. As for the ordinary course[128] of animals and other corporeal substances, which have hitherto been thought to be entirely extinguished, and whose changes depend on mechanical rather than on moral laws, I have noted with pleasure that the ancient author of the book De diaeta, which is attributed to Hippocrates, caught sight of a part of the truth when he expressly said that animals neither are born nor die and that the things which are thought to have a beginning and to perish actually merely appear and disappear. According to Aristotle, this is also the opinion of Parmenides and Melissus, for these ancient thinkers were sounder than we think.[129]

10. I am as ready as any man to do justice to the moderns. Yet I find that they have carried reform too far, among other things in confusing natural with artificial matters, because they have not held high enough ideas of the majesty of nature. They think that the difference between natural machines and ours is merely the difference between great and small. This led a very able man, the author of the Conversations on the Plurality of Worlds, to say recently that when we examine nature closely we find it less admirable than has been thought, it being merely like a craftsman's workshop—a conception which I consider neither just enough nor worthy enough of it.[130] It is only our system which shows us, at length, the real and immense distance which lies between the least productions and mechanisms of the Divine Wisdom and the greatest masterpieces of the craft of a finite mind. This difference consists

not merely in degree but also in kind. We must recognize that the machines of nature have a truly infinite number of organs, and are so well equipped and so completely proof against all accidents, that it is impossible to destroy them. A natural machine remains a machine even in its smallest parts, and, what is more, it always remains the same machine that it has been, being merely transformed through the different foldings which it undergoes, and being now extended, now compressed and, as it were, concentrated, when it is thought to have perished.

11. Furthermore, by means of the soul or form there is a true unity corresponding to what is called "I" in us. Such a unity could not occur in artificial machines or in a simple mass of matter, however organized it may be. For such a mass can be compared only to an army or a herd, or to a pond full of fish, or a watch made of springs and wheels. If there were no true substantial unities, however, there would be nothing substantial or real in the collection. It was this that forced Cordemoi to abandon Descartes and to support the Democritean theory of atoms in order to find a true unity in them.[131] But material atoms are contrary to reason, besides being still further composed of parts, since an invincible attachment of one part to another (if we could reasonably conceive or assume this) would not at all destroy the diversity of these parts. It is only atoms of substance, that is to say, real unities, that are absolutely destitute of parts, which are the sources of action and the absolute first principles out of which things are compounded, and, as it were, the ultimate elements in the analysis of substance. One could call them metaphysical points. They have something vital, and a kind of perception, and mathematical points are the points of view from which they express the universe. But when a corporeal substance is contracted, all its organs together make only one physical point with respect to us. Physical points are thus indivisible in appearance only, while mathematical points are exact but are nothing but modalities. It is only metaphysical points, or points of substance, constituted by forms or souls, which are exact

and real, and without them there would be nothing real, since there could be no multitude without true unities.[132]

12. Having established these things, I thought I had reached port. But when I began to think about the union of the soul with the body, it was like casting me back into the open sea, for I found no way to explain how the body causes anything to take place in the soul, or vice versa, or how one substance can communicate with another created substance. So far as we can know from his writings, Descartes gave up the struggle over this problem.[133] But seeing that the common opinion is inconceivable, his disciples concluded that we sense the qualities of bodies because God causes thoughts to arise in our soul on the occasion of material movements and that, when our soul in its turn wishes to move the body, God moves the body for it. And since the communication of motion also seemed inconceivable to them, they believed that God imparts motion to a body on the occasion of the motion of another body. This they call the System of Occasional Causes; it has had great vogue as a result of the beautiful reflections of the author of the Recherche de la vérite.

13. It must be admitted that this has definitely penetrated the difficulty in showing us what cannot take place. But it does not seem to have removed the difficulty by showing us what actually does happen. It is quite true that, speaking with metaphysical rigor, there is no real influence of one created substance upon another and that all things, with all their reality, are continually produced by the power of God. But problems are not solved merely by making use of a general cause and calling in what is called the deus ex machina. To do this without offering any other explanation drawn from the order of secondary causes is, properly speaking, to have recourse to miracle. In philosophy we must try to give a reason which will show how things are brought about by the Divine Wisdom in conformity with the particular concept of the subject in question.

14. Being constrained, then, to admit that it is impossible for the soul or any other true substance to receive something from without, except by the divine omnipotence, I was led insensibly to an

opinion which surprised me, but which seems inevitable, and which has in fact very great advantages and very significant beauties. This is that we must say that God has originally created the soul, and every other real unity, in such a way that everything in it must arise from its own nature by a perfect spontaneity with regard to itself, yet by a perfect conformity to things without. And thus, since our internal sensations, that is, those which are in the soul itself and not in the brain or in the subtle parts of the body, are merely phenomena which follow upon external events or, better, are really appearances or like well-ordered dreams, it follows that these perceptions internal to the soul itself come to it through its own original constitution, that is to say, through its representative nature, which is capable of expressing entities outside of itself in agreement with its organs—this nature having been given it from its creation and constituting its individual character. It is this that makes each substance represent the entire universe accurately in its own way and according to a definite point of view. And the perceptions or expressions of external things reach the soul at the proper time by virtue of its own laws, as in a world apart, and as if there existed nothing but God and itself (to make use of the expression of a person of exalted mind and renowned piety). So there will be a perfect accord between all these substances which produces the same effect that would be noticed if they all communicated with each other by a transmission of species or of qualities, as the common run of philosophers imagine. Furthermore, the organized mass in which the point of view of the soul is found is itself expressed more immediately by the soul and is in turn ready to act by itself following the laws of the corporeal mechanism, at the moment at which the soul wills but without either disturbing the laws of the other, the animal spirits and the blood taking on, at exactly the right moment, the motions required to correspond to the passions and the perceptions of the soul. It is this mutual agreement, regulated in advance in every substance of the universe, which produces what we call their communication and which alone constitutes the union of soul and body. This makes it clear how the soul has its seat in the body by an immediate presence which could not be closer, since the soul is in it as a unity is in the resultant of unities which is a multitude.

15. This hypothesis is entirely possible. For why should God be unable to give to substance in the beginning a nature or internal force which enables it to produce in regular order—as in an *automaton that is spiritual or formal but free* in the case of that substance which has a share of reason—everything which is to happen to it, that is, all the appearances or expressions which it is to have, and this without the help of any created being? Especially since the nature of substance necessarily demands and essentially involves progress or change and would have no force of action without it. And since it is the nature of the soul to represent the universe in a very exact way, though with relative degrees of distinctness, the sequence of representations which the soul produces will correspond naturally to the sequence of changes in the universe itself. So the body, in turn, has also been adapted to the soul to fit those situations in which the soul is thought of as acting externally. This is all the more reasonable inasmuch as bodies are made solely for the spirits themselves, who are capable of entering into a society with God and of extolling his glory. Thus as soon as one sees the possibility of this *hypothesis of agreement*, one sees also that it is the most reasonable one and that it gives a wonderful idea of the harmony of the universe and of the perfection of the works of God.

16. There is also in it the great advantage that, instead of saying that we are free only in appearance and in a manner adequate for practical purposes, as several intelligent persons have thought, we must rather say that we are determined only in appearance and that in metaphysical strictness we are in a state of perfect independence as concerns the influence of all the other created beings. This

throws a wonderful light on the immortality of our soul as well and on the always uniform conservation of our individual being, which is perfectly regulated by its own nature and fully sheltered from all accidents from without, whatever appearance there may be to the contrary. Never has a system so clearly exhibited our elevation. Since each mind is as a world apart and sufficient unto itself, independent of every other created being, enveloping the infinite and expressing the universe, it is as durable, as subsistent, as absolute as the universe of creatures itself. We must therefore conclude that it must always play such a part as is most fitting to contribute to the perfection of the society of all minds, which is their moral union in the City of God. A new proof of the existence of God can also be found here, one of surprising clarity. For the perfect agreement of so many substances which have no communication whatever with each other can come only from a common source.

17. In addition to all these advantages which recommend this hypothesis, we can say that it is something more than a hypothesis, since it seems hardly possible to explain things in any other intelligible way, and since a number of serious difficulties which have heretofore troubled thinkers seem to disappear of themselves when we rightly understand it. Ordinary ways of speaking can still be preserved. For one may say that when the particular disposition of one substance provides a reason for a change occurring in an intelligible manner, in such a way that we can conclude that the other substances have been adapted to it on this point from the beginning according to the order of the divine decree, then that substance should be thought of as *acting* upon the others in this sense. Further, the action of one substance upon another is not an emission or a transplanting of some entity, as is commonly supposed; and it can be understood reasonably only in the way just shown. It is true that we can easily conceive of both the emission and the reception of parts in matter and can in this way reasonably explain all the phenomena of physics mechanically. But since material mass is not a substance, it is clear that the action of substance itself can be only what I have just described.

18. However metaphysical these considerations may seem, they are also of remarkable service to physics in establishing the laws of motion, as my Dynamics will be able to show. For it can be said that in the collision of bodies each suffers only from its own elasticity, caused by the motion which is already within it. As for absolute motion, nothing can determine it mathematically, since everything ends in relations. The result is always a perfect equivalence in hypotheses, as in astronomy, so that, no matter how many bodies one takes, one may arbitrarily assign rest or some degree of velocity to any one of them we wish, without possibly being refuted by the phenomena of straight, circular, or composite motion.[134] However, it is reasonable to attribute true motions to bodies if we follow the assumption which explains the phenomena in the most intelligible way, for to do this is in conformity with the concept of activity which we have just established.

II

"Second Explanation of the New System"[135]

(Postscript of a Letter to Basnage de
Beauval, January 3/13, 1696)

[G., IV, 498-500]

I see clearly from your reflections that my thoughts, which a friend has had inserted in the Paris journal, are in need of clarification.

You say that you do not understand how I can prove what I have suggested about the communication or harmony of two substances as different as the soul and the body. It is true that I thought I provided a way to do so. And this is how I propose to satisfy you.

Imagine two clocks or watches which are in perfect agreement.[136] Now this can happen in three ways. The first is that of a natural influence. This is the way with which Mr. Huygens experimented, with results that greatly surprised him. He suspended two pendulums from the same piece of wood. The continued strokes of the pendulums transmitted similar vibrations to the particles of wood, but these vibrations could not continue in their own frequency without interfering with each other, at least when the two pendulums did not beat together. The result, by a kind of miracle, was that even when their strokes had been intentionally disturbed, they came to beat together again, somewhat like two strings tuned to each other. The second way of making two clocks, even poor ones, agree always is to assign a skilled craftsman to them who adjusts them and constantly sets them in agreement. The third way is to construct these two timepieces at the beginning with such skill and accuracy that one can be assured of their subsequent agreement.

Now put the soul and the body in the place of these two timepieces. Then their agreement or sympathy will also come about in one of these three ways. The way of influence is that of the common philosophy. But since it is impossible to conceive of material particles or of species or immaterial qualities which can pass from one of these substances into the other, this view must be rejected. The way of assistance is that of the system of occasional causes. But I hold that this makes a deus ex machina intervene in a natural and ordinary matter where reason requires that God should help only in the way in which he concurs in all other natural things. Thus there remains only my hypothesis, that is, the way of pre-established harmony,[137] according to which God has made each of the two substances from the beginning in such a way that, though each follows only its own laws which it has received with its being, each agrees throughout with the other, entirely as if they were mutually influenced or as if God were always putting forth his hand, beyond his general concurrence. I do not think that there is anything more than this that I need to prove—unless someone should demand that I prove that God is skilful enough to make use of this foresighted artifice, of which we see samples even among men, to the extent that they are able men. And, assuming that God can do it, it is clear that this way is the most beautiful and the most worthy of him. You had suspected that my explanation would be opposed to the different idea we have of the mind and of the body. But now you clearly see that no one could establish their independence more effectively. For as long as one was obliged to explain their communication by means of a miracle, one always gave opportunity for some people to fear that the distinction between body and soul is not as real as is thought, since we were forced to go to such lengths to maintain it. Now all these scruples will cease. My *Essays on Dynamics* are related to this, for in them it was necessary to explore the concept of corporeal substance, which I found in the force of action and resistance rather than in extension, the latter being merely a repetition or diffusion of something prior to it, namely, this force. These thoughts, which some people found paradoxical, have led to an exchange of letters with several famous people. I could publish a *commercium epistolicum* from them, which would also contain my correspondence with Mr. Arnauld, of which I spoke in my preceding letter. It would contain an interesting mixture of philosophic and mathematical ideas, which would perhaps sometimes have the grace of novelty. You yourself can judge, Sir, whether the explanations which I have given are suitable for sounding out the opinions of intelligent people if published in your journal—though without my name, as I was also unnamed in the Paris journal.

48

Letter to Gabriel Wagner on the Value of Logic

1696

Gabriel Wagner was a man of extended learning but with an insatiable appetite for controversy and conflict. Under the name of Realis de Vienna he published several works, including a criticism of Christian Thomasius which brought him into correspondence with Leibniz. Forced to leave Vienna, he settled in Hamburg in 1696 and there began a German weekly with the title Vernunftübungen, which he devoted to bitter attacks upon contemporary Scholasticism. An attack on logic in that paper gave occasion for the following letter, written in German.

* * *

[G., VII, 514-27]

Honorable Sir,

The fact that you had expressed your inclination and good opinion toward me publicly—and, indeed, far beyond my deserts—even before you made my acquaintance, made it all the more pleasant to receive your recent letter, together with your scholarly and thoughtful publication, the Vernunftübungen. I am under obligation to you to offer my thanks and my services, but especially to reveal to you sincerely my well-meant but tentative opinions on several matters, with the hope that you will accept them in good spirit and perhaps, after ripe consideration, find something useful in them.

I note, therefore, that your *Vernunftübungen* has given certain people an opportunity to grow indignant and to interpret it as a declaration of war against a kind of farcical learning which is now carried on in the higher schools and in others as well and which is universally praised and sought after. They hold that you oppose it in part, and especially insofar as it is removed from the knowledge of nature, and they view this as a deliberate effort to bring into derision and abuse by other people the whole class of those who deal in such learning. Now I am assured that this is not entirely your intention, and I cannot approve this extreme interpretation of it, especially since you have defended yourself against it and since I perceive from your Latin writings that you are yourself far from devoid of such learning, the style which you use in Latin (as well as in German) having an unusual amount of ornateness and expressiveness in the tradition of the ancients—which proves that you are not entirely lacking in, or opposed to, an acquaintance with them. But since there are several things which create the opposite impression, I am inclined to think that you would do well, Sir, to clear up a few matters, either in further issues of the *Vernunftübungen* or in some other public way, and thus rescue the honor of these scholars and remove a burden from yourself by giving assurance that you had no intention of finding fault either with the sciences or types of learning or with those who pursue and understand them and, least of all, that you wanted to scold or deride anyone.

For my part, I confess that in my early youth I was inclined to reject much of what had been introduced into the learned world. But with growing years and deeper insight I discovered the value of many things which I had before considered trivial, and I learned *not to condemn anything too easily*, a rule which I consider better and safer than that taught by certain Stoic lovers of wisdom and after them by Horace—*not to wonder at anything.* I have made this clear to the so-called Cartesians in France and elsewhere and have warned them that, by attacking the schools, they are helping neither themselves nor scholarship but are merely making learned men more bitter toward new ideas, however good. To some extent this actually happened, as the not entirely undeserved criticism by the learned Huet, Bishop of Avranches, proves.[138] And though Father Malebranche is otherwise my good friend, I have never been able to approve of his efforts to rule out, first, the critical study of Greek and Roman antiquities, then the reading of the rabbinical and Arabic literature, then the industry of the astronomers, and then something else, for, after all, these things all have their value, and it is good that there are people working at them, who must therefore be encouraged through praise further to pursue their great work, which they often carry on without reward, instead of being frightened away from it through contempt. I have no doubt that you are for the most part in agreement with this, since you have expressed yourself ably on oriental languages, astronomy, and other fields.

However, since you have in the main tended, if I understand you, to reject the art of reasoning or logic entirely and to ban it and its close relative, the universal science or metaphysics, and since you have explicitly included me (upon whom you bestow too much praise) among those who despise logic, I consider it all the more important to explain my position to you. I have no doubt that you have written as you have because of a sincere zeal for the true and useful sciences, so that men need not be delayed and led to lose valuable time through fruitless grubbing; and I do not doubt that you have honored me by calling upon me as witness to such a worthy aim. But as my opinion on the matter is in a certain measure different from yours, I should like to see if we can understand and compare each other's positions. I believe that you are right in your intentions but that your expressions say more than you mean. By logic or the art of reasoning I understand the art of using the understanding not only to judge proposed truth but also to discover hidden truth. If such an art is possible, in other words, if there are marked advantages to be found in such processes, it follows that it ought by all means to be sought and valued highly, indeed, to be considered as the key to all the arts and sciences. You seem to admit that there are excellent advantages to be gained by thought and investigation; if you are merely unwilling to admit that this procedure should be named logic, our controversy concerns only a word. But, since I do not think that this is your purpose, I can take your position to mean only that you are rejecting, not the true logic, but what we have heretofore honored by that name.

If this is your opinion, I must indeed confess that all our logics until now are but a shadow of what I should wish and what I see from afar; but I must also confess, to stick to the truth and give everyone his due, that I also find much that is good and useful in the logic of the past. Gratitude as well compels me to say this, for I think I can truthfully say that even the logic taught me in school has been most fruitful for me. Before I entered a class in which it was taught, I was steeped in the historians and poets, for I had begun to read history as soon as I could read at all, and I found great pleasure and value in verse. But as soon as I began to learn logic, I was greatly stirred by the classification and order which I perceived in its principles. I came at once to notice that there must be something great in it, as far as a lad of thirteen years could notice such a thing. My greatest pleasure lay in the categories, which seemed to me to be a standard roll of everything in the world, and I examined many logics to see where the best and most exhaustive lists could be found. I often asked myself and my companions into which category and subdivision of it this or that concept might belong, although I was not at all pleased to find that so many things were entirely excluded, and I found, too, that some of the categories, especially the last two or perhaps four, dropped away completely for me because they were included in the earlier ones or because I could find no actual use for them. I soon made the amusing discovery of a method of guessing or of recalling to mind, by means of the categories, something forgotten when one has a picture of it but cannot get at it in his brain. One needs only to ask one's self or others about certain categories and their subdivisions (of which I had compiled an extensive table out of various logics) and examine the answers, and one can readily exclude all irrelevant matters and narrow the problem down until the missing thing can be discovered. Nebuchadnezzar could perhaps have reconstructed his forgotten dream in this way. In such tabulations of knowledge I attained practice in division and subdivision as a basis of order and a bond of thoughts. Here the Ramists and Semi-Ramists were heavily drawn upon.[139] Whenever I found a list of things belonging together, and especially whenever I found a genus or universal under which a number of particular species was subsumed, as, for example, the number of the emotions or of the virtues and vices, I had to put them into a table and to see if the species fell into a successive order. I always found that the enumeration was incomplete and that more species could be added. I took great pleasure in such matters and wrote out all kinds of stuff, but then forgot it and let it be lost. Many years later, however, I found some of it and discovered that it did not entirely displease me. Later on I found the value of these exercises when I came to work out certain problems. I recall that once, when I had set up a construction of some kind, a learned friend asked me how I could think of everything that I had put in, even when its applicability was not at once apparent. I replied—what was true—that I did it by division and subdivision, using these as a net or snare to capture the elusive game. I found too that such division served to make for accurate descriptions of things, not to mention other advantages. Fortunately I was well advanced in the so-called humanities before this occurred to me, or I could hardly have prevailed upon myself to return again from the things to the words.

Many other ideas occurred to me, some of which I took to my teachers; among others whether, since simple terms or concepts are ordered through the known categories, one could not set up categories and ordered series for complex terms or truths as well.

For at that time I did not know that mathematical demonstrations were what I was seeking. I also observed that the topics or loci of the methods of explanation and demonstration were of great use in recalling for us, at the proper time, things already in our head but not in our thoughts, so that we might not merely prate about things but investigate them better. I observed that such loci or principles are to be used as sources, not merely for the methods of proving a represented truth, but also for the methods of explaining an object directly presented, and that we may thus speak of them not merely as principles of proof (*argumentabilia*) but also as principles of description (*predicabilia*).[140] Hence the five well-known predicables of Porphyry are totally inadequate, since they contain only predicates *in recto*, or denominations, and not even all these; one must add limitation (*definitio*; the Dutch call it *bepaeling*) and division, for it too is a predicable, for example, that every regular solid is either 4-, 6-, 8-, 12-, or 20-sided. But Porphyry overlooked the predicables which serve for predicates *in obliquo* or as sources of the secondary predicates [*anbeylagen*], if I may use such a word, and these are found in the topics, since cause, effect, whole, part, etc., are in fact of this kind.[141] I find that Placcius, the famed jurisconsult of Hamburg, whose learning, industry, profundity, and good opinion I esteem highly and whose patronage I would wish for you, has treated the *loci* ably and grasped the heart of the matter.[142] Jurists have made good use of these things in their *legal loci* and elsewhere. Upon them we may also develop a certain art of questioning which is useful not only for judges and recorders but also on journeys and in opportunities to see unusual things and speak with unusual persons from whom one may learn much, so that one can make the best use of such transient and never returning opportunities and not be angry with one's self later for having failed to ask questions or to observe this thing or that. Here belongs also the art of inquiry into nature itself and of putting it on the rack—the art of experimenting which Lord Bacon began so ably. You will reply that the ablest heads have no need of such advantages but get along well enough with their natural understanding and that simpletons cannot achieve as much with all such aids. There is some truth in this, but it is also true that there are few who know or make use of their advantages and that it is a misfortune for the human race that it has taken so little advantage of the grace revealed by God and of the treasures of benevolent nature. For I am of the opinion that men could accomplish things deemed incredible until now, if they really wanted to apply themselves to it, but their eyes are still holden, and everything takes time to ripen. So I am convinced that, with the advantage of these aids and the willingness to use them, a poor head could excel the best, just as a child with a ruler can draw better lines than the greatest master with free hand. The greatest geniuses, however, would make unbelievable progress if they added these advantages.

So far I have discussed only that part of the accepted logic which serves discovery and which, in a sense, should precede; now the part which concerns judgment must be considered. Here we come to the syllogisms and their figures and modes. This is the part which people hold to be the most useless; they make fun of Barbara and Celarent. My own observation has been different, however, and although Mr. Arnauld, in his Art of Thinking, thinks that men do not easily make errors in the form but almost always in the materials of thought, the situation is in fact quite otherwise.[143] Mr. Huygens has observed, as have I, that mathematical errors themselves, of the kind called paralogisms, usually arise through a neglect of form. It is certainly no small matter that Aristotle reduced these forms to unerring laws, having been the first actually to write mathematically outside of mathematics. For those who are interested, I too have contributed something, having demonstrated by my art of knowing that each of the four figures has exactly six valid modes and that therefore, in contrast to the popular doctrine, one figure has as many as another, nature being regular in everything.[144] This seems to me no less worthy of our consideration than the number of regular bodies. Aristotle's work is indeed but a beginning, virtually the ABC's, for there are other more complex and difficult forms which can be used only after these first and simple forms have been established, as, for example, the Euclidean inferences in which proportions are transposed and ratios inverted, compounded, divided, etc. Even addition, multiplication, and division of numbers, as they are learned in the arithmetic schools, are demonstrations in form, and we can depend upon them because they prove by virtue of their form. In this sense one may say that an entire bookkeeping calculation is formally demonstrable and consists in *demonstrations in form*. This is also true of *algebra* and many other formal proofs, which are indeed empty yet perfect. It is simply unnecessary for all forms of proof to be labeled *omnis, atque*, and *ergo*. Into all infallible sciences that are exactly demonstrated, higher logical forms are incorporated, some of which come from Aristotle, some of which must find their source elsewhere. Cardan saw this in his *Logic*. Just as counting on fingers and the use of lines and crosses are left to peasants, mathematicians having higher devices, so, when one has raised logic higher in the true sciences, one leaves to pupils this calculating by the fingers as it were, by means of *omnis, atque,* and *ergo*, by means of which they cannot count beyond three at a time, so to speak, because their inferences and syllogisms can have only three terms and three propositions. It is sometimes advisable, however, to stick to such peasant-calculating and child's logic. We sometimes accept small change in bunches but prefer to count over larger pieces, say, of gold, separately, and, if we had to count diamonds, we should gladly count them on our fingers, because such counting, though of the poorest type, is also the surest, whereas the higher, the more artificial, and the more rapid the counting, the greater the danger of error. So in logic also; in important matters such as theological controversies which concern the nature and will of God and also our soul we do well to analyze matters most industriously and reduce everything to the simplest and most easily grasped inferences, so that even the most insignificant student cannot fail to see what follows and what does not. It will be found that men have often reached a standstill and remain stuck in important discussions because they abandon form, just as we can change a ball of twine into a Gordian knot by trying to unwind it in a disorderly way.

In this connection I must set down my thoughts about the proper use of formal disputation. This has been banned from the lecture halls of both higher and lower schools, and one of the most important means of avoiding human errors has thus come to be considered almost as a child's game of which one is ashamed after he has progressed to something sounder. And it is no wonder that it is treated in this way, for it often seems that we do not want to use it to get behind the truth but only to give young people a little courage in showing themselves and defending themselves in public. Thus they commonly begin a syllogism, but the proposition which is denied or otherwise criticized is not in its turn established by a new syllogism, much less the disputed proposition in the prosyllogism, etc., as should be done in a true disputation in form. Instead, it is common to break off into conversation and informal discourse and to end in a word of honor or a compliment. Now I admit that it can hardly be otherwise if its purpose is merely to give youth practice. For if we wanted to carry through a formal disputation, several days would be spent on a syllogism, and where would the audience and the other opponents be then? The large number of prosyllogisms, moreover, would compose a real labyrinth from which we could not escape without a protocol, to say nothing of the great understanding and unusual acuteness needed to carry a demonstration back to its primary sources and fundamental truths on the spur of the moment. It is thus a human perversity to use logical form only where it can be of little help and must soon be stopped—that is, in oral controversies, and by young people, merely for practice. But where form might help us out of great difficulties, that is, in written theses for disputation, especially in important religious conflicts, we neglect it, with the result that there often arise harmful errors which are retained because in free discourse we think more of skill, eloquence, and subtlety, and of approval and esteem as well, than of the foundation of truth. The result is that, when both sides are defended by able and alert people, no decision is reached, but both sides are merely stiffened. I have often thought about this matter and have made some tests, and I find that whoever undertakes to prove something and constructs a syllogism for every wholly or partially denied proposition must inevitably finally stop because of the lack of proof and confess this or drive his opponents back to undeniable propostions and thus to an admission of truth, or (what sometimes happens in contingent matters) he must shift the burden of proof to his opponent. Thus the form of disputation has been shown to be necessary in necessary matters where eternal truths occur but not in contingent matters where the most probable must be chosen. In this case two further problems arise. The first concerns presumption, that is, when and how one has the right to shift the demonstration from one's self to someone else; the second concerns the degrees of probability, how to weigh and evaluate considerations which do not constitute a perfect demonstration but run counter to each other (indicantia and contraindicantia, the medics call them), and to reach a decision. For the common saying is true enough—rationes non esse numerandas sed ponderandas; arguments are not to be counted but weighed. But no one has as yet pointed out the scales, though no one has come closer to doing so and offered more help than the jurists. I have therefore thought a good bit about this matter and hope sometime to fill this need. This will also serve the art of exegesis and therefore be of use in theology. And it contains an infallible judge of conflicts, not indeed permitting us always to discover the truth, since God has often kept that for himself in the supreme secrets and has not revealed to us what we should like to know. But one can at least determine, first, whether the matter is perfectly proved, and then, if it is not, whether and to what extent it has been given credibility. I once carried out an experiment with a scholar in a semimathematical controversy. We were both seeking the truth, and we exchanged letters which, though courteous, were not without mutual complaints that each unintentionally distorted the meanings and utterances of the other. So I proposed the syllogistic form, which was agreeable to my opponent. We carried the matter beyond the twelfth prosyllogism, and, from the time we began this, complaints ceased, and we understood each other, to the advantage of both sides.[145] Since it is an easy and pleasant practice to arrange and rearrange syllogisms and prosyllogisms in formal replies, we should be able to use this method to get to the bottom of important scientific problems and to help free ourselves of dreams and conjectures. For the very nature of our procedure will eliminate all repetition, irrelevance, and unnecessary prolixity, as well as all deficiencies and omissions, whether intentional or unintentional, and, finally, all disorder, misunderstanding, and dishonest conduct of the argument as well.

This is what I wanted to say about the great, and for the most part tested, advantages of the known logic when it is rightly used. But I consider it certain that the art of reasoning can be carried incomparably higher and believe not only that I see this but that I already have a foretaste of it, which I could hardly have attained, however, without mathematics. Though I found some basis for it even before I was a novice in mathematics, and had already printed something about it in my twentieth year, I have finally come to see how blocked are the ways to it and how hard it would have been to open them without the aid of the deeper mathematics. What can actually be accomplished here is in my judgment of such scope that I cannot expect adequately to be believed without actual examples, and so must postpone a further exposition.

I shall therefore break off for this time and comment on the objections which you raise to logic. I find that they apply only to its abuse or misuse.

1. Logic as the art of reasoning may serve the purposes of order and of good discourse, even though those who teach it

neither order nor speak well. This merely means that they do not well understand or, at least, do not well practice their art. For one may understand everything that Ptolemy, Aristoxenus, and Zarlinus have written about music and yet not be able to sing or play.

2. If no one is convinced by logic, the reason for this is that no one takes the form or the orderly process seriously but uses it only for the amusement of youth or, rather, hardly tries to use it at all.

3. There is some truth in the assertion that a great part of the arts were discovered and can be taught with a purely natural logic. But a reasonable man who understands neither writing nor numbers ca also calculate with a natural arithmetic when necessary; does this prove that mathematics amounts to nothing? I myself am of the opinion that mathematics, history, and other subjects should be learned before an extensive mastery of logic, for how can one order one's thoughts who has never thought of much? But, once provided with a store of good ideas, one can survey and measure them, and, with the help of the order that is uncovered in them, one can all the more readily discover something new. This is similar to the art of speech. I am of the opinion that in learning a language one should stick to practice rather than to grammar. But once one is fairly proficient in the language, its grammar will help carry him further in it.

In addition to all this, I must also mention the fact that Plato achieved a good bit in logic and that disputation by means of questions also has its uses. I do not think that Archimedes and Descartes can be consider as despisers of logic; Descartes at least studied it most industriously under the Jesuits at La Fleche and was well at home in the Scholastic philosophy, which contains much that is good if it can only be dug out. I value Jung very highly and cannot adequately lament the loss of his manuscripts.[146] Nor do I put Felden in any low category, and the othe scholars whom you mention are also not to be despised.

4. But I cannot admit that logic has made no discoveries. Everyth discovered by the understanding has been discovered through the good rules of logic, although they may not have been explicitly noted or written down at the start. A good painter who has through practice

mastered true proportions uses the art of measuring and perspective, for even though he has not described or expressly known of these arts, their basis is in him. Meanwhile painting has become far more perfect since perspective has become a part of the art of knowledge.

5. There is no doubt that a man who is skilled in the advantages of the art of reasoning proceeds with more acuteness than others.

6. Men are reasonable without a formulated science of reasoning, just as they can sing without the art of music. But if as much industry had been applied to the true art of reasoning as has been expended on the art of singing, men would have accomplished wonders. We have neglected this because we pay little attention to things which are not immediately noticeable to the external senses. Cicero has well said that nothing is more beautiful than virtue, but how few see it! As for your remarks on the explanation of words, it will suffice to point out that these explanations at once involve the discovery of their cause, provided they are made by means of the definitions which I call real and which I have explained elsewhere. To take an example which is a little more difficult than the one you offer (why 3 times 4 is 12), why are the results of the successive addition of odd numbers always perfect squares? Thus

$$\begin{array}{ccccccc} 1+ & 3+ & 5+ & 7+ & 9+ & 11+ & 13 \\ \parallel & \parallel & \parallel & \parallel & \parallel & \parallel & \parallel \\ 1 & 4 & 9 & 16 & 25 & 36 & 49,\ \text{etc.} \end{array} \qquad \begin{array}{rrcl} & 1 & = & 1 \\ \text{or} & 3+1 & = & 4 \\ & 5+4 & = & 9 \\ & 7+9 & = & 16, \\ & 9+16 & = & 25,\ \text{etc.} \end{array}$$

In discovering the reason for this, we shall also discover the right use of the art of thought.

7. I have already admitted your assertion that everything may be learned without the art of judgment and have replied to it. Just as the Chinese have done many excellent things with only a natural art of measurement, so most things have been found out without using a proper art of thinking. Yet the value and utility of the art of thinking is established, as is that of the art of measuring.

8. It is true that the art of thinking must first be sought in examples of good thinking about things used as models. But after it has been found in these, we may attend directly to the art, so that it may itself become good and serve as a model, though without abandoning the practice and study of good thinking. A painter, sculptor, or architect studies ancient models and formulates an ideal from them. But these matters have also been reduced to rules which can be followed. Yet no one stops viewing beautiful works of art.

9. In spite of the transience and the complexity of human attitudes, there is only one art of thinking, although each person may follow his own inclinations in practice, just as there is only one art of riding which applies to all riders and horses, though not every saddle fits all horses. Numbers themselves may be grasped in many different ways. It is true that mathematics is not in itself logic, but it is one of its firstborn and applies it to magnitudes or to number, measure, and weight. I have discovered, too, that algebra derives its advantages from a much higher art, namely, the true logic.

10. Logic contains much that is difficult and much that is easy, just as does mathematics. What is easier than the first lesson in numbers, and what is more difficult than finding irrational roots? One may reasonably begin with the easiest and save the difficult until other sciences have been mastered. The beginnings will serve as a foretaste for youth, but the higher truths, both in logic and in arithmetic, belong to those who have come far in knowledge and in expression and wish to rise even higher. It is well known that Aristotle says of ethics, and Grotius of rhetoric, that they do not belong to students. I understand this to mean the higher use of these sciences, for Aristotle would not deprive youth of the *Civilitas Morum,* nor would Grotius forbid the *Progymnasmata* of Aphthonius.[147]

11. I should hold that all the consequences lie in the conclusions and not in the premises except only insofar as the latter involve something commensurate with the conclusions. This is true in all applications of science to contingent matters.[148] The art of *practice*

consists in bringing accidents themselves under the yoke of science. The more we do this, the more does theory conform to practice. For example, long ago only the force of motion was considered in mechanics. Galileo began to study mathematically the strength of the bodies used in motion and raised the question of which forms of the same matter offer the most resistance. Later I bettered and increased his rules. Galileo treated the motion of heavy bodies without considering the resistance of air. Blondel, in writing on bombs, also thinks that this is not necessary. On both rational and empirical grounds I hold the contrary.

12. The common logic is indeed often in error. What it says of genus and differentia needs improvement, for one can make a differentia out of the genus and vice versa, or, to speak whimsically but truthfully, one can say that man is an animal rational being with as much right as that man is a rational animal. When I say that a cube is a regular parallelopiped, I can take either term for genus or differentia.

13. I leave undecided the question of how far one may say that the pure logician is an ass. Scaliger said the same thing about mathematicians. Even a coachman could serve no purpose among men away from his coach or stable, if he showed no signs of understanding.

14. Pure mathematics proves nothing against logic. For it has borrowed much from logic, and it also comes to the rescue of logic, for its example serves to warn people, as may be seen in your twenty-third exercise. The spiral of Archimedes, which you mention there, is not so wonderful as may be thought. If something is continuously lifted more than it falls, is there any wonder that it is finally elevated? What you say of touching angles also has its limits, if rightly understood. If you admit infinite extension, it follows of course that one angle is greater than another. Your remark in the twentieth exercise, that there may be a moving object that is without motion, is not opposed to reason but only to the common semblance of it, and hence it is a paradox.

It must also be observed that the axis is not a part [of a revolving sphere]. Furthermore, just as it is not proper to be always making verses, so it is improper to be always throwing syllogisms about. To define or limit all terms is as little needed as to divide all numbers into their factors. I hold that juristic definitions too are logical.

15. If logic is nothing but a bag full of good reminders, it is certainly not futile. I have no praise for the new logicians who condemn the old rather than improve it. It is not always in our power to find the truth when not enough data are at hand, but we can always guard against error if we have time to think about a matter and to discover everything possible from the data—if we bring logic to full perfection. I have brought matters so far with my infinitesimal calculus of differences and sums that many problems can now be solved in mathematical physics which one could not even venture to try before. Even when data are lacking, we can at least observe what data we do need. If we had adequate practice in the true art of reason, it would also help us to thoughts which we must grasp on the spur of the moment, but, for the time being, we still lack most of such an art, and I have not had time to examine this point. I also admit that, when a logician gives a rule without an example, it is like trying to learn to duel with mere verbal instructions.

17. There is much that is excellent in Realis de Vienna, and this may be why he is not generally refuted. As for me, I lay little importance in refutation but much in exposition. When a new book reaches me, I search for what I can learn, not for what I can critize in it.

18. I think that the Sorbonne and other colleges are not to be despised. So far as I know, logic is in no more disrepute in France and England than in Germany. Yet I must agree that the most learned people do well to use few Scholastic terms especially in writing for general readers. Otherwise they are like a tailor who lets the seams show, as Mr. Dilher once appropriately said to me in discussing the use of such terms in pulpits.

In conclusion, I agree with you that, without making much ado about logic and such fields, we should lead youth at once into the factual sciences, just as I hold that languages are to be learned primarily through use, even though grammar is not to be rejected but to be used at the proper time for greater accuracy of speech. I hope these remarks, which have grown more extended than I had planned, will suffice to show you my thoughts and that they may serve to conciliate or moderate, since both sides do presuppose the art of reason, even though you try to restrict it to pure mathematics only, where it appears in its most beautiful form, though not entirely or exclusively. If I should have the good fortune to make peace between you and the common teaching tradition, it would give me much pleasure, for the result would be that you could find a greater opportunity not merely to attack what is useless but to construct, without being hindered, something of value for our common use.

49

Letters to Des Billettes

1696-97

Gilles Filleau (or Failaiseau) des Billettes was a pensioner of the Academy of Sciences in Paris and a distinguished expert in the arts and crafts, with wide and influential acquaintances. Like the Duke de Roannez, he had been a close friend of Pascal. Leibniz had known him during his Paris years and later called him "one of my oldest friends in France." The letters written to him contain popular expositions of Leibniz's philosophical ideas and throw some light upon his motives as a thinker.

* * *

I

[G., VII, 451-54]

December 4/14, 1696

Your health and your welfare, Sir, of which health is the more essential, have given me great joy. I am glad, too, that one can go to La Trappe without losing his fine curiosity and taking an aversion to terrestrial things; this could be good for certain people only. The gazette has already informed me of the death of the Duke de Roannez, for which I am sorry. You say, Sir, that the Duke had gone to the country in the interest of your works of navigation. Be so good as to tell me what these are and continue your kindness in sending me incidents which have to do with the sciences, as you have begun. Imagine that I were in Paris, having the honor of seeing you in the suburb St. Jacques as in former times, where the meetings seem since to have been banned. I thank you very much for what you wrote about Mr. Dalesme, inventor of the pneumatic tubes for carrying forces a great distance, and also for your story about the calculation of games of chance. But you forgot to give me the name of the Poitevin gentleman, the great gambler who thought of this application of mathematics. Most games could in fact give occasion for sound thinking, and I should like to have his views, as well as those of other gamesters. A small discourse of Mr. Huygens on the game of dice [de ludo aleae] is printed in the Exercitationes of Francis Schooten. It is a work separate from his commentary on Descartes's geometry.[149]

My system, about which you are interested in hearing some news, Sir, is not a complete body of philosophy, and I do not at all claim to give a reason for everything that others have claimed to explain. One must advance slowly to advance with sure steps. I begin with the principles, and I hope to be able to satisfy most doubts like those which perplexed the late Mr. Bernier. I believe that everything really happens mechanically in nature, and can be explained by efficient causes, but that at the same time everything also takes place morally, so to speak, and can be explained by final causes. These two kingdoms, the moral one of minds and souls and the mechanical one of bodies, penetrate each other and are in perfect accord through the agency of the Author of things, who is at the same time the first efficient cause and the last end. I claim, then, that just as there is no vacuum in bodies, no more is there one in souls; that is, that there are souls everywhere, and that souls which once exist cannot perish. Bodies are multitudes and souls are unities, but they are unities which express or represent within themselves the multitude. Every soul is a mirror of the entire world according to its point of view. But minds are souls of the first order or the highest genus, which represent not only the world but also God in the world. So they are not only immortal but conserve for always their moral qualities as citizens of the republic of the universe, which lacks nothing because it is God who rules it. My explanation of the union of soul and body is found in the thirty-eighth issue of the Journal des savants for this year.[150]

But I come to the points which you raise. As for gravity, Mr. Newton has shown us a proportion of which, however, I already knew something; the planets show us that weights or attractions are reciprocally proportional to the squares of their distances. A heavy body, that is, three times as far from the center of attraction will have only one-ninth of the weight. Now I find that this agrees with the action of light rays, for a fluid that is thin but solid will also take the form of emitted rays as it becomes distant from the center. It agrees also with motion away from the center along a tangent, which Kepler was the first to apply to gravity, Descartes following him in this. But merely the instantaneous conatus of the centrifugal force is not sufficient to form either light or gravity, as Descartes believed; a true motion of emission must be developed, like a puffing wind which requires time. Now the emission of a heavier or more compact fluid necessarily creates the attraction of bodies which are less so. As for light, I believe that an explosion is involved in the luminous body, as if an infinite number of air rifles [arquebuses à vent] were being discharged continuously. I hold also that all perceptible bodies are remarkably porous and permit more passage through them than we imagine. But when these passages are irregular, as when bodies are very dense or very mixed, they turn from transparent, as they really are, to opaque. I imagine that everything is continuous as well as contiguous, that is that these differ in degree and in appearance. The whole world is like a pond of matter in which there are different currents and waves. As for the sensibility of matter, I have already mentioned the souls which exist throughout it, and I believe that it is not properly the matter which is sensitive, since this is nothing but an aggregate of substances rather than one substance, but that it is rather the corporeal substance, which always has something analogous to feeling and life, being provided with an organic matter as well as a soul or, if you will, a form.

The action of percussion comes solely from elasticity, the operation of which arises only from the fact that the motion of the surrounding matter is troubled and impeded when it is inclosed, a little like the current of a river when it is narrowed. The force of fermentation, of cold and hot, of gunpowder, etc., can be explained by something analogous to the force of air guns or of a spring. For instance, it is not the little mass of gunpowder which causes so great an effect but the surrounding matter, as I have already said about elasticity. Calculating the action of powder, I find that the compression of air easily suffices to explain it. But I dare not hope that we shall very soon enter into the details of such matters. The origin of winds is due in part to the motion of the earth and to that of the light and heat from the sun on the earth, and even, in part, from the moon. Without speaking of exhalations to explain the magnet, these particles twisted into folds seem quite unnecessary; it suffices that the openings are so adjusted to what passes through them that, after this passage has continued for some time, its return is prevented and is against the grain, so to speak. A contrary effort changes these folds, however, and reverses them. As for the variation, we must labor to inform ourselves further about the fact.

Except for the general principles on the nature of corporeal substance, of force, and of the structure of the universe, which it is important to establish firmly, I find that our progress in physics is not yet very notable. All that we can do at present for medicine and the arts (I exclude mathematics, and mechanics, which depends on mathematics) is to observe the universal customs of nature, so to speak, in order to rule ourselves according to them. It is true that I believe that men will soon go much further if they press their point and profit by the methods which they have at hand. The Marquis de l'Hospital has himself had the goodness to throw light on my new infinitesimal calculus in the notable work which he has recently published.[151] I also call it the calculus of differences and sums. If peace is made, I believe there will be a way to introduce my arithmetical machine in France and that you will do me the honor of supporting it with your approval if you find it worthy.[152]

I beg you to send a few more details about Mr. Gayot, whose ability in mechanics you esteem so highly. Your testimony in such a matter is worth more than letters patent of the king. I must ask you a question. Can't one make some small bellows entirely out of steel or of some other metal, similar to a folding lantern? There would have to be thin strips at the places which must be flexible. This could be used to make a portable barometer like a watch, which would last a long time and would need no mercury or any other liquid, nor a fixed position. The use of barometers is important, as you know, in predicting the changes in the air.[153] You have many excellent ideas, Sir, of a mechanical as well as an economic-political nature. Why let them perish? Reflect on them a little, I pray you; you owe it to the public and to the honor of your nation. The Duke de Roannez had good ideas about water courses. Did he put anything in writing? I do not know whether you have seen the book on this subject by Mr. Guglielmini of Bologna. Mr. Papin has found many difficulties in it. Why haven't the Perier brothers published the mathematical essays of Pascal which they showed me?[154] Someone has told me that you have ideas for the improvement of printing; that would also be most useful. What is the present condition of what was once called the party of Port Royal? Does it still subsist in spite of the death of Mr. Arnauld and Mr. Nicole, and who are its buttresses? It seems to me that there are tools fit to facilitate the manufacture of clock wheels. This would help my arithmetical machine, which contains many such wheels. I beg you, Sir, to send me your opinion.

II

[GM., VII, 455-58]

Hanover, October 11/21, 1697

. . . Certainly we cannot gain over force; all that depends on us is to use it well. My fundamental maxim in mechanics, drawn from metaphysics, is that the cause and the total effect are always equivalent in such a way that the effect, if it were completely turned around, could always reproduce its cause exactly, and neither more nor less. So if the machinist who is trying to improve coaches sins against this principle, he will accomplish nothing of value. Thus someone told me, one day in Paris, that some German was said to have made a wooden horse which drew a carriage six German leagues in six hours by means of banded steel springs, as if it were possible to store so much force in so small a number of these springs. When I investigated, there was nothing to it. Yet it is true that we do not take enough advantage of the forces which nature supplies. . . .

Peace is made, and so I expect to hear that the arts and sciences are regaining force and vigor in France. You charm me besides, Sir, by telling me such beautiful things about the intentions and the zeal of the Abbé Bignon for advancing them.[155] My correspondence with Mr. Pelisson went further than with him, because our letters were more frequent. Aside from the very kind expressions of which the letters of the Abbé Bignon were full, no opportunity was found for a greater communication of our views. He must have greater and more beautiful ones than I, and, what is the main thing, he has the opportunity to carry them out. This pleases me, for often those who have the authority do not have enough light or enough ardor. I give way to him in everything except zeal. Provided that something of importance is achieved, I am indifferent whether it is done in Germany or in France, for I seek the good of mankind. I am neither a phil-Hellene nor a philo-Roman but a phil-anthropos. And I seek this, too, without desiring the slightest advantage from it, so that if I can contribute to his excellent plans, he may make free use of me without fear of being embarrassed. It is this that I beg you to tell him when an occasion arises. My work is not yet finished, so there is no hurry about it, and if there is some other difficulty which prevents the kind of printing of which he spoke, I will appreciate being informed of it in order to guide myself accordingly. I do not want to be importunate to anyone, and I have scruples against receiving a favor which I am not sure is being done me with pleasure. Since I know that some of your able geometricians often speak against the methods which I have proposed and which persons of importance and merit have carried further, without our having been able to get the critics to offer their objections in writing, I imagine that these men fear to give authority to my work by such a printing.[156] And it would be an injustice for me to wish the Abbé Bignon, in order to do me a favor, to disfavor persons whom he sees every day. If this is the cause of the difficulty, I shall esteem and honor him no less, and I shall be no less eager to give witness to my zeal toward him on every other occasion. I tell you these things sincerely and frankly, as to a common friend. And you will oblige me, Sir, if you will enlighten me about them. What good is dissimulation between people who ought to treat each other with realism and who ought to place themselves above the trifles which embarrass common people.

I believe that the descriptions of a good part of the arts can be made within the time which you mention, and I say that this will already be much. But since time is, in my opinion, the most precious of all things outside of ourselves over which we have control, I believe that one should almost double the number of persons in order to gain half of the time, if possible....

50

TENTAMEN ANAGOGICUM: AN ANAGOGICAL ESSAY IN THE INVESTIGATION OF CAUSES

Ca. 1696

Leibniz agreed with the Cartesians that natural events are to be explained mechanistically, but he insisted that the consideration of final causes was of significance in the derivation of mechanical laws themselves. As example he submitted a demonstration of the laws of refraction and reflection as a special case, maximally determined, of an infinite number of possible laws. His argument, historically important as the beginning of the famous dispute on the principle of *least action* in the eighteenth century, and the revived interest in a principle of the *extremum* today, was first published in the *Acta eruditorum* in June, 1682.[157] This clear and concise formulation is obviously later. The form and content suggest that it may be a continuation of the *Specimen dynamicum* (No. 46). The mention of the celebrated brachistochrone problem dates it after June, 1696, however, when John Bernoulli first proposed this problem. The essay remained unpublished until Gerhardt included it in his edition.

* * *

[G., VII, 270-79]

I[158] have shown on several occasions that the final analysis of the laws of nature leads us to the most sublime principles of order and perfection, which indicate that the universe is the effect of a universal intelligent power. As the ancients already held, this truth is the chief fruit of our investigations; without mentioning Pythagoras and Plato, whose primary aim was such an analysis, even Aristotle sought to demonstrate a prime mover in his works, particularly in his Metaphysics. It is true that these ancient thinkers were not informed about the laws of nature as are we, since they lacked many of the methods which we have and of which we ought to take advantage. The knowledge of nature gives birth to the arts, it gives us many means of conserving life, and it even provides us with conveniences; but the satisfaction of spirit which comes from wisdom and virtue, in addition to being the greatest ornament of life, raises us to what is eternal, whereas this life, in contrast, is most brief. As a result, whatever serves to establish maxims which locate happiness in virtue and show that everything follows the principle of perfection is infinitely more useful to man, and even to the state, than all that serves the arts. Discoveries useful to life, moreover, are very often merely the corollaries of more important insights; it is true here too that those who seek the kingdom of God find the rest on their way.

The inquiry into final causes in physics is precisely the application of the method which I think ought to be used, and those who have sought to banish it from their philosophy have not adequately considered its usefulness. For I do not wish to do them the injury of thinking that they have evil designs in doing this. Others followed them, however, who have abused their position, and who, not content with excluding final causes from physics but restoring them elsewhere, have tried to destroy them entirely and to show that the Creator of the universe is most powerful, indeed, but without any intelligence. There have been still others who have not admitted any universal cause, like the ancients who recognized nothing in the universe but a concourse of corpuscles. This seems plausible to those minds in whom the imaginative faculty predominates,[159] because they believe that they need to use only mathematical principles, without having any need either for metaphysical principles, which they treat as illusory, or for principles of the good, which they reduce to human morals; as if perfection and the good were only a particular result of our thinking and not to be found in universal nature.

I recognize that it is rather easy to fall into this error, especially when one's thinking stops at what imagination alone can supply, namely, at magnitudes and figures and their modifications. But when one pushes forward his inquiry after reasons, it is found that the laws of motion cannot be explained through purely geometric principles or by imagination alone. This is also why some very able philosophers of our day have held that the laws of motion are purely arbitrary. They are right in this if they take arbitrary to mean coming from choice and not from geometric necessity, but it is wrong to extend this concept to mean that laws are entirely indifferent, since it can be shown that they originate in the wisdom of their Author or in the principle of greatest perfection, which has led to their choice.

This consideration gives us the true middle term that is needed for satisfying truth as well as piety. We know that while there have been, on the one hand, able philosophers who recognized nothing except what is material in the universe, there are, on the other hand, learned and zealous theologians who, shocked at the corpuscular philosophy and not content with checking its misuse, have felt obliged to maintain that there are phenomena in nature which cannot be explained by mechanical principles; as, for example, light, weight, and elastic force. But since they do not reason with exactness in this matter, and it is easy for the corpuscular philosophers to reply to them, they injure religion in trying to render it a service, for they merely confirm those in their error who recognize only material principles. The true middle term for satisfying both truth and piety is this: all natural phenomena could be explained mechanically if we understood them well enough, but the principles of mechanics themselves cannot be explained geometrically, since they depend on more sublime principles which show the wisdom of the Author in the order and perfection of his work.

The most beautiful thing about this view seems to me to be that the principle of perfection is not limited to the general but descends also to the particulars of things and of phenomena and that in this respect it closely resembles the method of *optimal forms,* that is to say, of forms *which provide a maximum or minimum,* as the case may be—a method which I have introduced into geometry in addition to the ancient method of *maximal and minimal quantities.* For in these forms or figures the *optimum* is found not only in the whole but also in each part, and it would not even suffice in the whole without this. For example, if in the case of the curve of shortest descent between two given points, we choose any two points on this curve at will, the part of the line intercepted between them is also necessarily the line of shortest descent with regard to them.[160] It is in this way that the smallest parts of the universe are ruled in accordance with the order of greatest perfection; otherwise the whole would not be so ruled.

It is for this reason that I usually say that there are, so to speak, two kingdoms even in corporeal nature, which interpenetrate without confusing or interfering with each other—the realm of power, according to which everything can be explained *mechanically* by efficient causes when we have sufficiently penetrated into its interior, and the realm of wisdom, according to which everything can be explained architectonically,[161] so to speak, or by final causes when we understand its ways sufficiently. In this sense one can say with Lucretius not only that animals see because they have eyes but also that eyes have been given them in order to see, tho I know that some people, in order the better to pass as free thinkers, admit only the former. Those who enter into the details of natural machines, however, must have need of a strong bias to resist the attractions of their beauty. Even Galen, after learning something about the function of the parts of animals, was so stirred with admiration that he held that to explain them was essentially to sing hymns to the honor of divinity. I have often wished that an able physic would undertake to prepare a special work whose title—or whose aim, at least—would be *The Hymn of Galen.*

What is more, our thinking sometimes furnishes us with considerations revealing the value of final causes, not merely in increasing our admiration for the supreme Author, but also in making discoveries among his works. Some day I shall show this in a special case in which I shall propose as a general principle of optics that a ray of light moves from one point to another by the path which is found to be easiest in relation to the plane surfaces which must serve as the rule for other surfaces. For it must be kept in mind that if we claimed to use this principle as an efficient cause, and as if the easiest path would prevail among all the possible competing rays, it would be necessary to consider the whole surface as it is, without considering the plane tangent to it, and then the principle would not always work out successfully, as I shall show presently.[162] But far from concealing that there is a certain final cause involved in this principle—an objection which was once made against Mr. Fermat, who had used it in his Dioptrics—I have found it more beautiful and more important than that of mechanism for a more sublime application. And an able author who has published a work on optics in England has expressed his indebtedness to my view.[163] Order demands that curved lines and surfaces be treated as composed of straight lines and planes, and a ray is determined by the plane on which it falls, which is considered as forming the curved surface at that point. But the same order demands that the effect of the greatest ease be obtained in relation to the planes, at least those which serve as elements to other surfaces, since it cannot be obtained with regard to these surfaces also. This is all the more true since it thus satisfies, with respect to these curves, another principle which now supersedes the preceding one, and which holds that in the absence of a minimum it is necessary to hold to the most determined, which can be the simplest even when it is a maximum.

Now we find that the ancients, and among others Ptolemy, already used this hypothesis of the easiest path of a ray which falls on a plane, to account for the equality of the angles of incidence and reflection, the principle at the basis of catoptrics. It is by this same hypothesis that Mr. Fermat provided a reason for the law of refraction according to the sines, or to formulate it in other terms, as Snell did, according to the secants. But, what is more, I have no doubt whatever that this law was first discovered by this method. It is known that Willebrord Snell, one of the greatest geometricians of his time and well versed in the methods of the ancients, invented it, having even written a work which was not published because of its author's death. But, since he had taught it to his disciples, all appearances point to the conclusion that Descartes, who had come to Holland a little later and who was most interested in this problem, learned it there. For the way in which Descartes has tried to explain the law of refraction by efficient causes or by the composition of directions in imitation of the reflection of bullets is extremely forced and not intelligible enough. To say no more about it here, it shows clearly that it is an afterthought adjusted somehow to the conclusion and was not discovered by the method he gives. So we may well believe that we should not have had this beautiful discovery so soon without the method of final causes.

I recall that capable writers have frequently objected that this principle does not seem to work in reflection itself when applied to curved surfaces and that in concave mirrors the path of reflection happens sometimes to be the longest. But in addition to what I have already said, that, according to architectonic principles, curved surfaces must be ruled by the planes tangent to them, I shall now explain how it remains always universally true that the ray is directed in the most determined or unique path, even in relation to curves. It is also worth noting that, in the method of analysis by maxima and minima, the same operation suffices for the problems of the greatest and the smallest, without distinguishing between them except in applying the method to different cases, since we seek the most determined magnitude in both cases, which is sometimes the greatest and sometimes the smallest in its order, the analysis being based solely on the disappearance of a difference or on the unique result of reuniting twins, and not at all on a comparison of the greatest and smallest with all other magnitudes. For given a curve AB, concave or convex, and an axis ST to which the ordinates of the curve are referred; then it is seen that to each ordinate, like Q or R, there corresponds another one equal to it, its twin, q or r(Fig. 33). But there is one particular ordinate EC which is unique, or the only determinate one of its magnitude, and has no twin, since the two twins EC and ec coincide in it and make but one. And this EC is the greatest ordinate of the concave curve and the smallest of the convex curve. So instead of two infinitely near ordinates in all other cases, having a difference of dm if the ordinate is called m, whose ratio to Ee, a correspondingly small part of the axis, would give the angle of the curve or of its tangent to the axis ST, the infinitely close ordinates or twins become coincident in this case at C and have no difference; dm becomes 0, and the tangent at C is parallel to the axis. Thus the basis of the analysis is this uniqueness caused by the union of the twins, without any concern as to whether the ordinate is the greatest or smallest. The calculus shows us this in particular, in this very matter. Let ACB be any mirror whatever, plane, concave, or convex; and let two points F and G be given (Fig. 34). To find the point of reflection C, such that the path FCG is the unique, singular, or most determined path in size, or what the ancients once called the μοναχὸν, either the greatest or the smallest, that is, whichever it happens to be. For those which are not unique in this sense are doubles or twins, having another of the same length corresponding to them. Draw FG, whose middle point is H, and between C and FG draw CB perpendicular to FG, and CP perpendicular to the mirror. Call HF or HG a, HB x, CB y; then BP will be -ydy, dx being taken

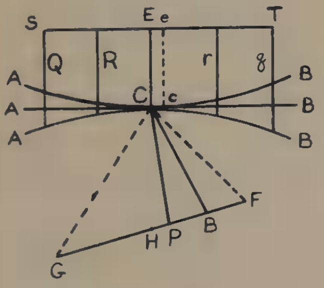

Fig. 33

negatively. Then CF will be $\sqrt{y^2 + x^2 - 2ax + a^2}$, and CG will be $\sqrt{y^2 + x^2 + 2ax + a^2}$. Now $CF + CG = m$. Differentiating, one gets $d \cdot CF + d \cdot CG = 0$; that is,

$$\frac{ydy + xdx - adx}{CF} + \frac{ydy + xdx + adx}{CG} = 0,$$

or

$$\frac{CF}{CG} = \frac{(a - x - ydy)\ dx}{(a + x + ydy)\ dx}.$$

But $a - x$ is BF and $a + x$ is GB. Therefore

$$\frac{CF}{CG} = \frac{BF + BP}{GB - BP},$$

or

$$\frac{CF}{CG} = \frac{PF}{PG}.$$

This shows that the angle of direction FCG is bisected by CP, the perpendicular to the curve,[164] or that the angles of incidence and of reflection are equal, whatever may be the reflecting surface.

The same truth holds also with regard to refraction; that is, whether the surface of separation be plane or curved, provided only that it be uniformly determined, the broken ray always passes from a point in one medium to a point in the other medium by the most determined or unique path, which has, so to speak, no twin brother in length of time. This is something I do not remember having seen commented on before. It is easy to prove it by an analysis similar to that given above. Let a figure be set up just like that above, except that instead of a mirror there is a surface ACB, flat, concave, or convex, which separates two media penetrated by the ray, and which changes its direction. The ratio of the resistance of the of the medium $ACBF$ to that of the medium $ACBG$ shall be as f to g; then $f \cdot CF + g \cdot CG = m$.

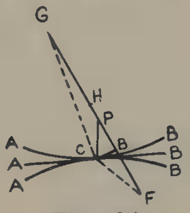

Fig. 34

Differentiating, we get

$$\frac{f\,(ydy + xdx - adx)}{CF} + \frac{g\,(ydy + xdx + adx)}{CG} = 0,$$

and as a result (calculating as above),

$$\frac{CF}{CG} = \frac{f \cdot PF}{g \cdot PG}.$$

Now it is easy to derive from this theorem the proportionality of sines. For let the ray *FC* strike the refracting surface *ACB* at *C*, and let the refracted ray, *CG*, be taken equal to the incident ray *FC*. Draw *FG* cutting the straight line *CP* perpendicular to the surface, at *P*. From points *F* and *G* draw normals *FL* and *GN* to *CP* (Fig. 35). Now since *CG* and *CF* are taken equal, it follows by the equation of the preceding paragraph that *PF* is to *PG* as *g* to *f*. Then because of the similar triangles *PLF* and *PNG* the sine *FL* will be to the sine *GN* as *g* to *f*,[165] that is, reciprocally as the resistances of the media. And the sines of the angles of refraction will be proportional to the sines of the angles of incidence.[166]

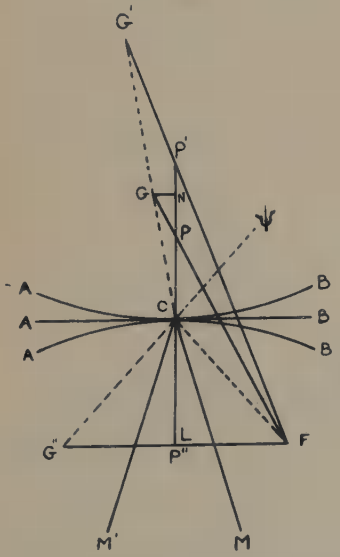

Fig. 35

This makes us see, finally, that the rule of the unique path, or the path most determined in length of time, applies generally to the direct and the broken ray, whether reflected or refracted, whether by plane or by curved surfaces, whether convex or concave, without distinguishing in the process whether the time is the longest or the shortest, though it is in fact the shortest when that which should provide the rule is taken into consideration, that is, the tangent plane; nature being governed, as it is, by sovereign wisdom, shows the general design throughout of controlling curves by straight lines or planes tangent to them, as if the curves were composed of these, although this is not strictly true.

One also comes in this way to understand some general theorems common to catoptrics and dioptrics. For the rectangle constructed by multiplying the ray on one side of the surface by the opposite segment of the base line (namely, the rectangle $CF \cdot PG$) is always proportional to the corresponding rectangle on the opposite side, made by multiplying the ray of the other side by the segment of the base opposite it (that is, the rectangle $CG \cdot PF$); or the ratio of the product of one side of the broken ray times the opposite segment of the base, to the product of the other side of the ray by its opposite segment is equal to the ratio of the resistances of the opposite media. In the case of simple reflection, where the media have the same nature, this becomes the ratio of equals, and then this theorem gives

$$\frac{CF \cdot P''G''}{CG'' \cdot P''F} = 1 \text{ [167]}$$

or

$$CF \cdot P''G'' = CG'' \cdot P''F,$$

or, as above,

$$\frac{CF}{CG''} = \frac{P''F}{P''G''};$$

that is, the angles of incidence and reflection are equal.

But there could still be a case of reflection mixed with refraction, of which the solution is easy; for that proposed by Descartes does not seem consistent with the nature of light. The ray FC could at the same time meet the mirror ACB and the new medium MCA or M'CA at C, in which case it would be reflected backward, but the angle of reflection would not be equal to the angle of incidence. It will not be difficult to determine this, since one has only to think, in place of the ray FC, of the ray ϒC which would pass, if continued directly, into CG'', and it will be found that the ray FC, falling upon the mirror CB and into the new medium CM at the same time, will then be turned, by reflection and refraction together, to go as the ray ΨC would go if turned by the refraction of the medium CM alone.

This principle still deserves to be studied empirically, however, not to determine the quantity, but to see whether it can perhaps give us something specific, especially with regard to colors. Thus I should also like to have someone investigate empirically another transition from refraction to reflection, which occurs when the ray which strikes the medium has taken on an obliqueness too great to penetrate it; I should like to have this case, too, applied to colors as well as to a crystal of double reflection.[168] This also deserves application, furthermore, to the experiences of color arising from refraction. But this is said in passing.

This principle of nature, that it acts in the most determined ways which we may use, is purely architectonic in fact, yet it never fails to be observed. Assume the case that nature were obliged in general to construct a triangle and that for this purpose only the perimeter or the sum of the sides were given, and nothing else; then nature would construct an equilateral triangle. This example shows the difference between architectonic and geometric determinations. Geometric determinations introduce an absolute necessity, the contrary of which implies a contradiction, but architectonic determinations introduce only a necessity of choice whose contrary means imperfection—a little like the saying in jurisprudence: *Quae contra bonos mores sunt, ea nec facere nos posse credendum est.*[169] So there is even in the algebraic calculus what I call the law of justice, which greatly aids us in finding good solutions. If nature were brutish, so to speak, that is, purely material or geometrical, the above case would be impossible, and, unless something more determinative were given than merely the perimeter, nature would not produce a triangle. But since nature is governed architectonically, the half-determinations of geometry are sufficient for it to achieve its work; otherwise it would most often have been stopped. And this is particularly true with regard to the laws of nature. Perhaps someone will deny that what I have said above applies to the laws of motion and will maintain that an entirely geometric demonstration can be given of them. I reserve the proof of the contrary for another discourse, where I shall show that they cannot be derived from their sources without assuming architectonic grounds. One of the most important of these, which I believe I am the first to have introduced into physics, is the law of continuity, which I discussed many years ago in the Nouvelles de la république des lettres, where I showed with examples how it serves as the touchstone of theories.[170] It serves not merely to test, however, but also as a very fruitful principle of discovery, as I plan to show some day. But I have also found other very beautiful and extended laws of nature, quite different, however, from those usually employed, yet always depending on architectonic principles. Nothing seems to me to be more effectual in proving and admiring the sovereign wisdom of the Author of things as shown in the very principles of things themselves.

51

ON THE RADICAL ORIGINATION OF THINGS[171]

November 23, 1697

Leibniz's shift of emphasis to a posteriori reasoning for the existence of God is nowhere better exemplified than in this essay, unpublished until 1840, when Erdmann included it in his edition. The new phase of his metaphysics is concerned with the implications of particularity and its difference from mere possibility. The problem of the paper is the implication of this particular natural order for the nature of the ultimate harmony of ideas, and it is therefore also important for his hedonistic perfectionism in ethics and aesthetics. The close relationship with the preceding and following essays will be apparent (Nos. 50, 52, and 53). At the close there is a growing emphasis on temporal progress which is characteristic of Leibniz's later thought.

* * *

[G., VII, 302-8]

Besides the world or aggregate of finite things, there is a certain One which is dominant, not only as the soul is dominant in me or, rather, as the Ego itself is dominant in my body, but also by a much higher reason. For the dominant One of the universe not only rules the world but fabricates or makes it; it is superior to the world and, so to speak, extramundane, and hence is the ultimate reason for things. For a sufficient reason for existence cannot be found merely in any one individual thing or even in the whole aggregate and series of things. Let us imagine the book on the Elements of Geometry to have been eternal, one copy always being made from another; then it is clear that, though we can give a reason for the present book based on the preceding book from which it was copied, we can never arrive at a complete reason, no matter how many books we may assume in the past, for one can always wonder why such books should have existed at all times; why there should be books at all, and why they should be written in this way. What is true of books is true also of the different states of the world; every subsequent state is somehow copied from the preceding one (although according to certain laws of change). No matter how far we may have gone back to earlier states, therefore, we will never discover in them a full reason why there shoul be a world at all, and why it should be such as it is.

Even if we should imagine the world to be eternal, therefore, the reason for it would clearly have to be sought elsewhere, since we would still be assuming nothing but a succession of states, in any one of which we can find no sufficient reason, nor can we advance the slightest toward establishing a reason, no matter how many of these states we assume. For even though there be no cause for eternal things, there must yet be understood to be a reason for them. For permanent things this reason is their necessity or essence itself; but in a series of changing things (if this is taken a priori[172] to be eternal) it is a prevailing of inclinations, as we shall see presently, for here reasons do not necessitate (in the sense of an absolute or metaphysical necessity, whose contrary implies a contradiction), but incline. These considerations show clearly that we cannot escape an ultimate extramundane reason for things, or God, even by assuming the eternity of the world.

The reasons for the world therefore lie in something extramundane, different from the chain of states or series of things whose aggregate constitutes the world. And so we must go from physical or hypothetical necessity, which determines later things in the world from earlier ones to something which has absolute or metaphysical necessity, for which no reason can be given. The present world is necessary in a physical or hypothetical sense, not absolutely or metaphysically. That is, once it is established to be such as it is, it follows that things such as they are will come into being. Therefore, since there must be an ultimate root in something which has metaphysical necessity, and since there is no reason for an existing thing except in another existing thing, there must necessarily exist some one being of metaphysical necessity, or a being to whose essence belongs existence. So there must exist something which is distinct from the plurality of beings, or from the world, which, as we have admitted and shown, has no metaphysical necessity.

To explain a little more distinctly, however, how temporal, contingent, or physical truths arise out of truths that are eternal and essential, or, if you like, metaphysical, we should first acknowledge that, from the very fact that something exists rather than nothing, there is a certain urgency [exigentia] toward existence in possible things or in possibility or essence itself—a pre-tension to exist, so to speak—and, in a word, that essence in itself tends to exist. From this it follows further that all possible things, or things expressing an essence or possible reality, tend toward existence[173] with equal right in proportion to the quantity of essence or reality, or to the degree of perfection which they involve; for perfection is nothing but quantity of essence.

Hence it is very clearly understood that, out of the infinite combinations and series of possible things, one exists through which the greatest amount of essence or possibility is brought into existence. There is always a principle of determination in nature which must be sought by maxima and minima; namely, that a maximum effect should be achieved with a minimum outlay, so to speak. And at this point time and place, or, in a word, the receptivity or capacity of the world, can be taken for the outlay, or the terrain on which a building is to be erected as commodiously as possible, the variety of forms corresponding to the spaciousness of the building and the number and elegance of its chambers. The case is like that of certain games in which all the spaces on a board are to be filled according to definite rules, but, unless we use a certain device, we find ourself at the end blocked from the difficult spaces and compelled to leave more spaces vacant than we needed or wished to. Yet there is a definite rule by which a maximum number of spaces can be filled in the easiest way. Therefore, assuming that it is ordered that there shall be a triangle with no other further determining principle, the result is that an equilateral triangle is produced.[174] And assuming that there is to be motion from one point to another without anything more determining the route, that path will be chosen which is easiest or shortest. Similarly, once having assumed that being involves more perfection than nonbeing, or that there is a reason why something should come to exist rather than nothing, or that a transition from possibility to actuality must take place, it follows that, even if there is no further determining principle, there does exist the greatest amount possible in proportion to the given capacity of time and space (or the possible order of existence), in much the same way as tiles are laid so that as many as possible are contained in a given space.

We can now understand in a wonderful way how a kind of divine mathematics or metaphysical mechanism is used in the origin of things and how the determination of the maximum takes place. So the right angle is the determined one of all angles in geometry, and so liquids placed in a different medium compose themselves in the most spacious figure, a sphere. But best of all is the example in ordinary mechanics itself; when many heavy bodies pull upon each other, the resulting motion is such that the maximum possible total descent is secured.[175] For just as all possibilities tend with equal right to existence in proportion to their reality, so all heavy objects tend to descend with equal right in proportion to their weight. And just as, in the latter case, that motion is produced which involves the greatest possible descent of these weights, so in the former a world is produced in which a maximum production of possible things takes place.

Thus we now have a physical necessity derived from a metaphysical necessity. For even if the world is not necessary metaphysically, in the sense that its contrary would imply a contradiction or logical absurdity, it is nonetheless necessary physically, or determined in such a way that its contrary would imply imperfection or moral absurdity. And just as possibility is the principle of essence, so perfection or degree of essence is the principle of existence (since the degree of perfection determines the largest number of things that are compossible). This shows at once how there may be freedom in the Author of the world, even though he does all things determinately because he acts on the principle of wisdom or perfection. Indifference arises from ignorance, and, the wiser a man is, the more determined he is toward the most perfect.

But, you will say, however elegant this comparison may seem, of a kind of determining metaphysical mechanism with the physical mechanism of heavy bodies, it is faulty in this respect—heavy bodies which act against each other truly exist, whereas possibilities or essences, whether prior to or abstracted from existence, are imaginary or fictitious, and therefore we cannot look for a reason for existence in them. I answer that neither these essences nor the so-called eternal truths about them are fictitious but exist in a certain region of ideas, if I may so call it, namely, in God himself, who is the source of all essence and of the existence of the rest. The very existence of the actual series of things shows that this is not merely a gratuitous assertion of mine. For since no reason can be found for this series within itself, as I have shown above, but this reason is to be sought in metaphysical necessity or in eternal truth, and since, furthermore, existing things can come into being only from existing things, as I have also explained, it is necessary for eternal truths to have their existence in an absolutely or metaphysically necessary subject, that is, in God, through whom those possibilities which would otherwise be imaginary are (to use an outlandish but expressive word) realized.[176]

And we do in fact observe that everything in the world takes place in accordance with the laws of the eternal truths and not merely geometric but also metaphysical laws; that is, not merely according to material necessities but also according to formal reasons. And not only is this true in general, on the principle which we have just explained—that there should exist a world rather than none and that this world should exist rather than another. (This may be learned in any case from the tendency of possibles toward existence.) But it is true also when we descend to special cases and see the wonderful way in which metaphysical laws of cause, power, and action are present throughout all nature, and how they predominate over the purely geometric laws of matter themselves, as I found to my great admiration when I was explaining the laws of motion. As I have fully explained elsewhere, I was at length compelled to give up the law of the geometric composition of conatuses which I had formerly defended when, as a youth, I was more materialistic.[177]

We therefore have the ultimate reason for the reality of essences as well as existences in one being, which must necessarily be greater, higher, and prior to the world itself, since not only the existing things which compose the world but also all possibilities have their reality through it. But because of the interconnection of all these things, this ultimate reason can be found only in a single source. It is evident, however, that existing things are continuously issuing from this source and are being produced and have been produced by it, since no reason appears why one state of the world should issue from it rather than another, that of yesterday rather than today's. It is clear, too, how God acts not merely physically but freely as well, and how there is in him not only the efficient but the final cause of the world. Thus we have in him the reason not merely for the greatness and power in the world mechanism as already established, but also for the goodness and wisdom exerted in establishing it.

In case anyone may think that this confuses moral perfection or goodness with metaphysical perfection or greatness, and may deny the former while granting the latter, it must be recognized that it follows from what has been said that the world is not only the most perfect naturally or, if you prefer, metaphysically—in other words, that that series of things has been produced which actually presents the greatest amount of reality—but also that it is the most perfect morally, because moral perfection is truly natural[178] in minds themselves. Hence the world not only is the most wonderful mechanism but is also, insofar as it consists of minds, the best commonwealth, through which there is conferred on minds as much felicity or joy as possible; it is in this that their natural perfection consists.

You may object, however, that we experience the very opposite of this in the world, for often the very worst things happen to the best; innocent beings, not only beasts but men, are struck down and killed, even tortured. In fact, especially if we consider the government of mankind, the world seems rather a kind of confused chaos than something ordained by a supreme wisdom. So it seems at first sight, I admit, but, when we look more deeply, the opposite can be established. A priori it is obvious from the principles which I have already given that the highest perfection possible is obtained for all things and therefore also for minds.

And as the jurisconsults say, it is truly unjust to render a judgment without having studied the whole law. We know but a very small part of an eternity stretching out beyond all measure. How tiny is the memory of the few thousand years which history imparts to us! Yet from such slight experience we venture to judge about the immeasurable and the eternal; as if men born and reared in prison or in the underground salt mines of Sarmatia should think that there is no other light in the world but the wretched torch which is scarcely sufficient to guide their steps. If we look at a very beautiful picture but cover up all of it but a tiny spot, what more will appear in it, no matter how closely we study it, indeed, all the more, the more closely we examine it, than a confused mixture of colors without beauty and without art. Yet when the covering is removed and the whole painting is viewed from a position that suits it, we come to understand that what seemed to be a thoughtless smear on the canvas has really been done with the highest artistry by the creator of the work. And what the eyes experience in painting is experienced by the ears in music. Great composers very often mix dissonances with harmonious chords to stimulate the hearer and to sting him, as it were, so that he becomes concerned about the outcome and is all the more pleased when everything is restored to order. Similarly we may enjoy trivial dangers or the experience of evils from the very sense they give us of our own power or our happiness or our fondness for display. Or again, in witnessing performances of rope-dancing or sword-dancing [*sauts perilleux*], we are delighted by the very fears they arouse, and we playfully half-drop children, pretending to be about to throw them away for much the same reason that the ape carried King Christian of Denmark, when he was still a baby dressed in long clothes, to a rooftop and then, while everyone waited in terror, returned him, as if in play, to his cradle. By the same principle it is insipid always to eat sweets; sharp, sour, and even bitter things should be mixed with them to excite the taste. He who has not tasted the bitter does not deserve the sweet; indeed, he will not appreciate it. This is the very law of enjoyment, that pleasure does not run an even course, for this produces aversion and makes us dull, not joyful.

But what I have said about a part being disturbed without destroying the harmony in the whole must not be interpreted as if there is no reason for the parts or as if it were enough for the world to be perfect as a whole, even though the human race should be wretched and there should be no concern in the universe for justice and no account taken of us, as is held by some people who have not made sound judgments about the totality of things. For we must recognize that, just as care is taken in the best-ordered republic that individuals shall fare as well as possible, so the universe would not be perfect enough unless as much care is shown for individuals as is consistent with the universal harmony. No better measure for this matter can be set up than the law of justice itself, which dictates that each one shall take part in the perfection of the universe and his own happiness according to the measure of his own virtue and the degree to which his will is moved toward[179] the common good. And in this very thing is fulfilled what we call the charity and the love of God, in which alone the force and power of the Christian religion also consist, according to the opinion of wise theologians. Nor should it seem remarkable that so much respect should be shown to minds in the universe, since they resemble most closely the image of the supreme Author and are related to him not merely as machines to their maker—as are other beings—but also as citizens to their prince. Moreover, they are to endure as long as the universe itself and in some way to express the whole and concentrate it in themselves, so that it can be said that minds are total-parts.

As for the afflictions, especially of good men, however, we must take it as certain that these lead to their greater good and that this is true not only theologically but also naturally. So a seed sown in the earth suffers before it bears fruit. In general, one may say that, though afflictions are temporary evils, they are good in effect, for they are short cuts to greater perfection. So in physics the liquids which ferment slowly also are slower to settle, while those in which there is a stronger disturbance settle more promptly, throwing off impurities with greater force. We may well call this stepping back in order to spring forward with greater force [qu'on recule pour mieux sauter]. These views must therefore be affirmed not merely as gratifying and comforting but also as most true. And, in general, I hold that there is nothing truer than happiness and nothing happier and sweeter than truth.

As the crown of the universal beauty and perfection of the works of God, we must also recognize that the entire universe is involved in a perpetual and most free progress, so that it is always advancing toward greater culture. Thus a great part of our earth has now received cultivation and will receive it more and more. And though it is true that some sections occasionally revert into wilderness or are destroyed and sink back again, this must be understood in the same sense in which I have just explained the nature of afflictions, namely, that this very destruction and decline lead to a better result, so that we somehow gain through our very loss.

To the objection which could be offered, moreover, that if this were so, the world should long since have become a paradise, there is an answer near at hand. Although many substances have already attained great perfection, yet because of the infinite divisibility of the continuum, there always remain in the abyss of things parts which are still asleep. These are to be aroused and developed into something greater and better and, in a word, to a better culture. And hence progress never comes to an end.

52

CLARIFICATION OF THE DIFFICULTIES WHICH MR. BAYLE HAS FOUND IN THE NEW SYSTEM OF THE UNION OF SOUL AND BODY

Histoire des ouvrages des savants, July, 1698

Of the criticisms which the *New System* (No. 47) evoked, none was more penetrating than that which Pierre Bayle attached to the article "Rorarius" in the second volume of his *Dictionnaire historique et critique* appearing in 1697. His criticism covered many points but centered on the interpretation of the relation between mind and body. Leibniz sent the following reply in the form of a letter to Basnage de Beauval, editor of the *Histoire*, which had succeeded Bayle's own *Nouvelles de la république des lettres.*

* * *

[G., IV, 517-24]

I take the liberty, Sir, of sending you this clarification of the difficulties which Mr. Bayle has found in the hypothesis I proposed to explain the union of soul and body. Nothing is kinder than the consideration which he shows for me, and I hold myself honored by the objections which he has put in his excellent *Dictionary*, in the article on "Rorarius." So great and profound a mind as his, moreover, cannot but instruct, and I shall strive to profit by the light which he has shed on these matters in this article and at many other points in his work. He does not reject what I have said about the conservation of the soul or even that of the animal, but he still does not seem satisfied with the way in which I have tried to explain the union and intercourse of the soul and the body in the Journal des savants for June 27 and July 4, 1695, and in the Histoire des ouvrages des savants for February, 1696.[180]

These are the words which seem to indicate where he finds the difficulty. He says:

> I am unable to understand the chain of internal and spontaneous actions which would cause the soul of a dog to feel pain immediately after having felt joy, even if it were alone in the universe.

I reply that when I said that even if only it and God existed in the world, the soul would feel all that it feels now, I was merely using a fiction, assuming something which cannot happen naturally, in order to show that the feelings of the soul are entirely a result of what is already in it. I do not know whether the proof of the incomprehensibility which Mr. Bayle finds in this "chain" is to be sought only in what he says later or whether he already means to suggest it in the example of the spontaneous transition from joy to pain, perhaps by trying to show that such a transition is contrary to the axiom that a thing always remains in the state in which it is at a certain time, unless something occurs to compel it to change, and that therefore, if an animal once is in a state of joy, it will always be in such a state if it is alone or if there is nothing external to make it pass over into pain. In any case, I agree with the axiom; I even maintain that it favors my position, since it is in fact one of its foundations. For do we not conclude from this axiom, not only that a body at rest always remains at rest, but also that a body in motion will always retain its motion or its process of change, that is to say, the same speed and direction, if nothing occurs to impede it? Thus a thing not only remains in the state in which it is, insofar as it depends on itself, but also continue to change when it is in a state of change, always following one and the sam law. But in my opinion it is the nature of created substance to change continually following a certain order which leads it spontaneously (if I may be allowed to use this word) through all the states which it encounters, in such a way that he who sees all things sees all its past and future states in its present. And this law of order, which constitutes the individuality of each particular substance, is in exact agreement with what occurs to every other substance and throughout the whole universe. Perhaps I shall not claim too much if I say that I can demonstrate all this, but for the present the question is merely to maintain it as a possible hypothesis which is suitable for explaining phenomena. Now it is in this way that the law of change in the substance of the animal carries it from joy to pain in that moment in which there takes place a break in the continuous processes in its body, because it is the law of the indivisible substance of the animal to represent what occurs in its body in the way in which we experience it, and even to represent in some way, through its relation to this body, everything which occurs in the world. For the substantial unities are nothing but different concentrations of the universe represented according to the different points of view by which they are distinguished.[181]

Mr. Bayle continues:

> I understand why a dog passes immediately from pleasure to pain if we strike him with a stick just when he is very hungry and is eating some bread.

I am not sure that we do fully understand this. No one knows better than Mr. Bayle himself that it is just here that the great difficulty lies in explaining why whatever occurs in the body makes a change in the soul, and that it is this which has forced the defenders of occasional causes to have recourse to the care which God must take to represent continually in the soul the changes which occur in its body. I believe instead that it is the soul's own God-given nature to represent everything that takes place in its organs by virtue of its own laws. Bayle continues:

> But that his soul is constructed in such a way that he should feel pain at the moment he is struck even if no one were to strike him, and even if he were to continue to eat bread without difficulty or interruption—this I cannot understand.

Nor do I recall having said this. And one can speak in this way only by a metaphysical fiction, as when one assumes that God destroys a body in order to create a vacuum; the one is as contrary to the order of things as the other. For since the nature of the soul has been made in such a way from the beginning as to represent successively the changes of matter, the situation which we assume could not arise in the natural order. God could give to each substance its own phenomena independent of those of others, but in this way he would have made as many worlds without connection, so to speak, as there are substances, almost as we say that, when we dream, we are in a world apart and that we enter into the common world when we wake up. Not that dreams do not also correspond with the organs and the rest of the body, but in a less distinct way. Let us continue with Mr. Bayle. He says:

> I find too that the spontaneity of this soul is most incompatible with the feelings of pain and, in general, with all perceptions which are displeasing to it.

This incompatibility would certainly exist if spontaneous and voluntary meant the same thing. Everything voluntary is spontaneous, but there are spontaneous actions which are not chosen and therefore are not voluntary. It does not rest with the soul always to give itself feelings which please it, since the feelings which it will have are dependent upon those which it has had. Mr. Bayle says further:

> Furthermore, it seems to me that this able man dislikes the Cartesian system because of a false assumption, for one cannot say that the system of occasional causes makes the action of God intervene by a miracle (deus ex machina) in the reciprocal dependence of body and soul. For since God's intervention follows only general laws, he does not therein act in an extraordinary way.

This is not the only reason why I dislike the Cartesian system. And when my own is given a little consideration, it becomes clear what I find in it that makes me adopt it. Even if the hypothesis of occasional causes should have no need for miracles, it seems to me that my own would still have other advantages. I have pointed out that we can imagine three systems to explain the intercourse which we find between body and soul; namely, (1) the system of the mutual influence of one upon the other, which when taken in the popular sense is that of the Scholastics, and which I consider impossible, as do the Cartesians; (2) that of a perpetual supervisor who represents in the one everything which happens in the other, a little as if a man were charged with constantly synchronizing two bad clocks which are in themselves incapable of agreeing—this is the system of occasional causes; and (3) that of the natural agreement of two substances such as would exist between two very exact clocks. I find this view fully as possible as that of a supervisor and more worthy of the author of these substances, clocks or automata. But let us see whether the system of occasional causes does not in fact imply a perpetual miracle. Here it is said that it does not, because God would act only through general laws according to this system. I agree, but in my opinion that does not suffice to remove the miracles. Even if God should do this continuously, they would not cease being miracles, if we take this term, not in the popular sense of a rare and wonderful thing, but in the philosophical sense of that which exceeds the powers of created beings. It is not enough to say that God has made a general law, for besides the decree there is also necessary a natural means of carrying it out, that is, all that happens must also be explained through the nature which God gives to things. The laws of nature are not so arbitrary and so indifferent as many people imagine. For example, if God were to decree that all bodies should have a tendency to move in circles and that the radii of the circles should be proportional to the magnitude of the bodies, one would either have to say that there is a method of carrying this out by means of simpler laws, or one would surely have to admit that God must carry it out miraculously, or at least through angels charged expressly with this responsibility, somewhat in the manner of those that were once assigned to the celestial spheres. It would be the same if someone said that God has given natural and primitive gravities to bodies by which each tends to the center of its globe without being pushed by another body, for in my opinion such a system would need a perpetual miracle, or at least the help of the angels.[182]

> Does the internal and active power communicated to the forms of bodies know the series of actions which it must produce? By no means, for we know by experience that we are ignorant of what kinds of perceptions we shall have in an hour.

I reply that this power, or, better, this soul or form itself, does not know them distinctly but that it does feel them confusedly. In each substance there are traces of everything which has happened to it and of everything which will happen to it. But this infinite multitude of perceptions prevents us from distinguishing them, just as I cannot distinguish one voice from another when I hear the loud confused noise of a crowd.

> Then it would be necessary for the forms to be directed by some external principle in producing their acts. But would this not be the deus ex machina exactly as in the system of occasional causes?

This deduction is avoided by the preceding answer. On the contrary, the present state of each substance is a natural result of its preceding state, but there is only one infinite intelligence which, because it envelops the universe, can see this result in souls as well as in each portion of matter.

Mr. Bayle ends with these words:

> Finally, since he assumes with good reason that all souls are simple and indivisible, we cannot understand how they can be compared to a clock. That is, they are able to vary their operations by their original constitution, making use of the spontaneous activity which they receive from their creator. We conceive clearly that a simple being will always act uniformly if no external cause interferes with it. If it were composed of many pieces, like a machine, it would act diversely because the particular activity of each piece could at any moment change the course of all the others. But in a single substance, where can you find the cause of a change in operation?

I find this objection worthy of Mr. Bayle, and one of those which are most in need of clarification. But I also believe that if I had not taken care of it from the start, my system would not deserve study. I have compared the soul with a clock only with regard to the regulated precision of its changes, which is only imperfect even in the best clocks, but which is perfect in the works of God. And one can say that the soul is a most exact immaterial automaton. When it is said that a simple being will always act uniformly, a distinction needs to be made. If to act uniformly is to follow perpetually the same law of order or of succession, as in a certain scale or series of numbers, I agree that in this sense every simple being and even every composite being acts uniformly. But if uniformly means similarly,[183] I do not agree. To explain the difference this meaning makes, by means of an example, a movement in a parabolic path is uniform in the former sense but not in the latter, for the parts of the parabolic curve are not similar to each other as are the parts of a straight line. It is true, I may say in passing, that a simple body left to itself will describe only straight lines, speaking only of the center which represents the movement of the whole body. But when a simple and rigid body has once received a rotation or circular motion about its center, and retains it in uniform direction and uniform speed, the result is that such a body, left to itself, can describe circular lines at points other than its center when the center is at rest, and even certain quadratrices when the center is in motion, curves whose ordinates are compounded of the straight line traversed by the center and of the sine [of the rotated angles], the cosine being the abscissa, and the arc being related to the circumference as the straight line traversed is to a given line.[184]

We must also take into consideration that the soul, however simple it may be, always has a feeling [sentiment] composed of many perceptions at once, a fact which serves our purpose as well as if it were composed of parts like a machine. For each preceding perception influences those which follow in conformity with a law of order which is found in perceptions as well as in movements. For many centuries, too, most philosophers, who ascribe thoughts to souls and to angels, whom they believe to be without any bodies (not to speak of the intellects of Aristotle), have admitted spontaneous change in simple beings. I add that the perceptions which are found together in one soul at the same time include a veritably infinite multitude of little indistinguishable feelings, which the subsequent series must develop, so that we need not be astonished at the infinite variety of what must result from it in time. All this is only a consequence of the representative nature of the soul, which must express what happens, and even what will happen in its body and in some way in all other bodies, through the connection or correspondence between all the parts of the world. Perhaps it would have sufficed to say that God, having made material automatons, could also make immaterial ones which represent the former ones, but I believed that it would be well to elaborate my views a little more fully.

As for the rest, I have read with pleasure what Mr. Bayle says in the article on Zeno.[185] Perhaps he could perceive that the conclusions which can be drawn from it agree better with my system than with any other, for what is real in extension and movement consists of nothing but the foundation of order and the regular sequence of phenomena and perceptions. Also, the Academics and skeptics, as well as those who tried to answer them, seem chiefly to have been involved in difficulties merely because they sought a greater reality in things outside of us than that of well-regulated phenomena. We conceive of extension in conceiving an order in coexistences, but we should not conceive of it, any more than of space, in the nature of a substance. The same is true of time, which presents to the mind only an order in changes. As for motion, that which is real in it is force or power, namely, something in the present state which carries with it a change for the future. The rest is only phenomena and relations. Consideration of this system also shows that, when we penetrat to the foundations of things, we observe more reason than most of the philosophical sects believed in. The lack of substantial reality in the sensible things of the skeptics; the reduction of everything to harmonies or numbers, ideas, and perceptions by the

Pythagoreans and Platonists; the one and the whole of Parmenides and Plotinus, yet without any Spinozism; the Stoic connectedness, which is yet compatible with the spontaneity held to by others; the vitalism of the Cabalists and hermetic philosophers who put a kind of feeling into everything; the forms and entelechies of Artistotle and the Scholastics; and even the mechanical explanation of all particular phenomena by Democritus and the moderns; etc.—all of these are found united as if in a single perspective center from which the object, which is obscured when considered from any other approach, reveals its regularity and the correspondence of its parts. Our greatest failure has been the sectarian spirit which imposes limits upon itself by spurning others. The formalist philosophers find fault with the materialists or corpuscular philosophers, and vice versa. We wrongly impose limits upon the divisibility and subtlety, as well as on the riches and beauty of nature, when we assume atoms and a void, when we imagine certain first elements (as do even the Cartesians)[186] in place of veritable unities, and when we do not recognize the infinite in everything, and the exact expression of the greatest in the smallest, combined with the tendency of each one to develop itself in a perfect order. This is the most admirable and the most beautiful effect of the sovereign principle whose wisdom and bounty leave nothing better to be desired by those who are able to understand its economy.

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ON NATURE ITSELF, OR ON THE INHERENT FORCE AND ACTIONS OF CREATED THINGS[187]

Acta eruditorum, September, 1698

Robert Boyle's proposal, in his Free Inquiry into the Vulgarly Received Notion of Nature (1686), that the term "nature" should be avoided and "mechanism" substituted for it occasioned a controversy between John Christopher Sturm of Altdorf and Gunther Christopher Schelhammer of Kiel in 1697-98, in which Sturm defended Boyle's opinion, while Schelhammer defended the concept of nature. One of the points argued concerned the source and nature of motion, Sturm defending the Cartesian position that God is its only source. Though the correspondence which began between Leibniz and Sturm in 1695 avoided the central question of the status of nature, it turned on the independent reality of the natural order, including man, Sturm maintaining that it is pagan and un-Christian to attribute properties to "the nature of things" and that nature has no energy or force proper to itself. Leibniz's published reply is directed not only at Sturm but at the occasionalists and others who in effect deny the reality of the physical world. It contains a careful exposition of his reasons for a pluralistic, energistic system, and one pre-eminent for its revelation of the motives and the nature of his argument.

* * *

[G., IV, 504-16]

1. I have recently had sent to me the apology published in Altdorf by that most noted and, in mathematical and physical matters, deservedly famous man, John Christopher Sturm, in defense of his dissertation De idolo naturae, which had been attacked by an outstanding and most gifted physician of Kiel, Gunther Christopher Schelhammer, in a book on nature.[188] I too had long ago pondered the same problem, and I had also carried on a kind of disputation by letter with the famous author of the dissertation, which he himself has recently mentioned in a way that honors me, since he makes public mention of certain papers which passed between us in the first volume of his Elective Physics (Book I, Sec. 1, chap. iii; Epilogue, Sec. 5). I was therefore all the more willing to set my mind and attention to this argument which is so important in itself, judging it necessary to explain my own opinion and the problem itself a little more clearly in terms of the principles which I have now stated so many times. His apologetic dissertation seems to offer a convenient occasion for beginning this, for we may judge that the author has here set forth, in few words and from a single perspective, the most important issues involved in the matter. I am not making the quarrel between these famous men my own, however.

2. Two questions are, I believe, of most importance. The first: In what does the nature consist which we customarily ascribe to things, whose attributes, as they are usually understood, Mr. Sturm considers to reek somewhat of paganism? The second: Whether there is any energy in created things. This he seems to deny. As for the first question, on nature itself, if we are to discover both what it is and what it is not, I agree that there is no world soul; and I admit also that the wonderful events which occur daily and because of which we commonly say, rightly, that the work of nature is a work of intelligence are not to be ascribed to certain created intelligences endowed with wisdom and power proportional to such a task. But

universal nature is, so to speak, the *artifice of God*, and such a work, indeed, that any natural machine whatever consists further of infinite organs (this is the true, but little noted, distinction between *nature* and *art*) and so entails an infinite wisdom and power on the part of its author and governor. So I consider the omniscient heat of Hippocrates, the soul-giving cholcodea of Avicenna, the most wise plastic power of Scaliger and others, and Henry More's hylarchic principle to be in part impossible and in part superfluous.[189] I consider it sufficient that the mechanism of the world is built with such wisdom that these wonderful things depend upon the progression of the machine itself, organic things particularly, as I believe, evolving by a certain predetermined order. And I agree when this illustrious man rejects the figment of a certain wise created nature which forms and governs the mechanisms of physical bodies. But I do not agree, and I do not think it conformable to reason, that we should deny that any active creative force resides in things.

3. I have said what nature is not; let us now examine a little more closely what this nature is which Aristotle has well called the *principle of motion and of rest*, though that philosopher seems to me to take the term more broadly than its accepted meaning, and to understand by it not only local motion and rest in a place, but change and στάσις or permanence in general.[190] I may also point out in passing that the definition which he gives of motion, though more obscure than it should be, is not as inept as it seems to those who assume that he meant to define only local motion. But to return to the point. Robert Boyle, a man of distinction and thoroughly at home in the observation of nature, wrote a little work *On Nature Itself*, the argument of which, if I remember rightly, amounted to this—that we must hold nature to be the *mechanism* of bodies itself. Superficially this can be approved, but, to examine the matter with greater care, we must distinguish principles from derivative matters within this same mechanism; thus it is not enough in explaining a clock to say that it is

moved by a mechanical principle, without further distinguishing whether it is driven by a weight or by a spring. I have already expressed, more than once, a view which I believe will be of use in preventing mechanical explanations of natural things from being carried to abuse in injuring piety, as if matter can stand by itself and mechanism needs no intelligence or spiritual substance—the view, namely, that the origin of this mechanism itself has come, not from a material principle and mathematical reasons alone, but from a higher and, so to speak, a metaphysical source.

4. One important indication of this, among others, is provided by the foundation of the laws of nature, which is not to be found in the principle that the same quantity of motion is conserved, as had commonly been held, but rather in the principle that the same quantity of active power is necessarily conserved, and indeed—a thing which I discovered happens for a most beautiful reason—the same quantity of motive action also, the value of which is far different from what the Cartesians think of as the quantity of motion. After two mathematicians who easily rank among the foremost in ability had discussed this matter with me, partly in letters and partly in publications, one of them came over to my camp completely, and the other, after long and accurate thought, came to the point of abandoning all his objections and frankly confessed that he had not yet thought of any answer to my demonstration.[191] I have therefore been all the more astonished that in explaining the laws of motion in the published part of his Elective Physics, this famous man has accepted the popular opinion about these matters as if no doubt of it were possible, though he himself acknowledges that it rests upon no demonstration but only upon a kind of probability; this he has repeated in his latest discussion, chapter iii, Section 2. But perhaps he wrote this before my own views had appeared, and then either had no time to revise what he had written or did not think of it, especially since he believed that the laws of motion are arbitrary—a view which does not seem to me to be entirely consistent. For I think that God has been led to set in motion the laws which

are observed in nature through determined principles of wisdom and by reasons of order; and that this makes clear what I once pointed out in discussing the laws of optics (a view to which the famous Molyneux later gave his approval in his *Dioptrics*), that final causes are useful not only for virtue and piety, in ethics and natural theology, but also for discovering and detecting hidden truths in physics itself.[192] So I could have wished that when the famous Sturm, in dealing with final causes in his *Elective Physics*, referred to my opinion among the hypotheses, he might also have appraised it fully in his criticism, for he would then undoubtedly have taken occasion to say many excellent things in behalf of the excellence and fruitfulness of the argument—things which would be useful for piety as well.

5. But now we must examine what he says in this apologetic dissertation of his about the concept of nature and what seems still to be lacking in what he says. He admits (chap. iv, Secs. 2, 3, and elsewhere) that motions now taking place result by virtue of an *eternal law* once established by God, which law he then calls a volition and *command*, and that no new command or new volition of God is then necessary, much less a new conatus or some laborious effort (Sec. 3). And he rejects as wrongly ascribed to him by his opponent the opinion that God moves things as a woodchopper moves his ax or a miller controls his mill by shutting off the water or turning it into the wheel. But this explanation does not seem to me to do justice to the truth. For I ask whether this volition or command, or, if you prefer, this divine law once established, has bestowed upon things only an *extrinsic denomination* or whether it has truly conferred upon them some created impression which endures within them, or as Mr. Schelhammer, who is as distinguished in judgment as in experience, very well puts it, an *internal law* from which their actions and passions follow, even if this law is mostly not understood by the creatures in which it inheres. The former view seems to be that of the authors of the system of occasional causes, especially of the

ingenious Mr. Malebranche; the latter is the accepted view, and I believe the truest.

6. For since this command in the past no longer exists at present, it can accomplish nothing unless it has left some subsistent effect behind which has lasted and operated until now, and whoever thinks otherwise renounces any distinct explanation of things, if I am any judge, for, if that which is remote in time and space can operate here and now without any intermediary, anything can be said to follow from anything else with equal right. It is not enough, therefore, to say that, in creating things in the beginning, God willed that they should observe a certain law in their progression, if his will is imagined to have been so ineffective that things were not affected by it and no durable result was produced in them. In any case it also conflicts with the concept of the divine power and will, which are pure and absolute, for God to will and yet to produce or change nothing by his willing, for him always to act but never to achieve and not to leave behind any work or any accomplishment [ἀποτέλεσμα]. Surely if nothing has been impressed upon creatures by that divine word *producat terra, multiplicemini animalia*,[193] if things are affected after the command just as if no command had intervened, it follows—since some connection, either immediate or mediated by something, is necessary between cause and effect—either that nothing conforming to the command is now happening or that the command was valid only in the present and must always be renewed in the future. But the learned author rightly repudiates this view. If, on the other hand, the law set up by God does in fact leave some vestige of him expressed in things, if things have been so formed by the command that they are made capable of fulfilling the will of him who commanded them, then it must be granted that there is a certain efficacy residing in things, a form or force such as we usually designate by the name of nature, from which the series of phenomena follows according to the prescription of the first command.

7. This inherent force can indeed be understood distinctly,

though it cannot be explained by sense perception. It is no more to be thus explained than is the nature of the soul, for this force belongs among those things which are grasped, not by the imagination but by the understanding. Therefore I interpret this learned man's request (in chap. iv, Sec. 6, of his "Apologetic Dissertation") that we explain to the imagination the way in which such an inherent law can operate in bodies ignorant of law, as meaning that he wants it explained to the understanding, for otherwise it might be thought that he was asking for sounds to be painted or colors heard. Furthermore, if difficulty in explaining something is a sufficient reason for rejecting it, this must also be applied, to be consistent, to the view which he complains is ascribed to him unjustly (chap. i, Sec. 2), namely, that he prefers to hold that all things are moved by divine force alone rather than to admit anything by the name of nature of whose nature he is ignorant. Certainly Hobbes and others who try to make everything corporeal could also depend on this argument with as much right, since they have convinced themselves that only body can be explained distinctly and in sensible imagery. But these men are rightly refuted by the very fact that there is a power of action in things which we do not derive from sensible images. And simply to refer this back to a command of God, given at one time in the past and in no way affecting things or leaving an effect behind it, is so far from explaining the matter that it is rather to put aside the role of the philosopher and to cut the Gordian knot with a sword. For the rest, a more distinct and accurate explanation of active force than has heretofore been given may be drawn from my *Dynamics*, which contains an appraisal of the laws of nature and of motion that is true and in harmony with things.

8. But if some advocate of the new philosophy which maintains the inertness and deadness of things should go so far as to deprive God's commands of all lasting effect and efficiency in the future, and to regard it as nothing to demand of him always new arrangements (a view which Mr. Sturm wisely rejects as foreign to his own), it is h

own affair to decide how worthy he considers this of God. But we cannot excuse him from giving us a reason why things themselves can have an enduring permanence while the attributes of things, which we designate as their "nature," cannot have this permanence. For it is nevertheless consistent that, just as the word *fiat* leaves behind it something permanent, namely, the persisting thing itself, so the word *benedictio* leaves behind it something in things no less wonderful—a fruitfulness or an impulse to produce their actions and to operate, from which activity follows if nothing interferes.[194] To this can be added the point I have made elsewhere, though perhaps not everyone has understood it adequately as yet, namely, that the substance of things itself consists in the force of acting and being acted upon; hence it follows that no enduring thing can be produced if no force that long endures can be impressed upon it by the divine power. Then it would follow that no created substance, no identical soul, would be permanent, and hence that nothing would be conserved by God, but everything would reduce to certain evanescent and flowing modifications or phantasms, so to speak, of the one permanent divine substance. And, what reduces to the same thing, God would be the nature and substance of all things—a doctrine of most evil repute, which a writer who was subtle indeed, but irreligious, in recent years imposed upon the world, or at least revived.[195] Surely if corporeal things contained nothing but matter, they could most truly be said to consist of a flux and to have nothing substantial, as the Platonists long ago recognized.

9. The *second question* is whether created beings may be said properly and truly to act. If we once understand that their internal nature is no different from the force of acting and suffering, this question reduces to the former one, for there can be no action without a force of acting, and, conversely, a power which can never be exercised is meaningless. Yet since action and power are different things, the former a matter of succession, the latter permanent, let us examine action also. Here I

confess I find no little difficulty in explaining the opinion of the famous Mr. Sturm. For he denies that created things by themselves properly act, yet he nonetheless admits that they do act, since he is unwilling to have ascribed to him the comparison of created things with an ax moved by a woodcutter. I can make out nothing certain from this; he does not seem to me to have explained very clearly how much he departs from accepted opinions, nor what sort of distinct concept of action he has in mind—for that the concept of action is not an easy or obvious one is clear from the conflicts of the metaphysicians. So far as I have made the concept of action clear to myself, I believe that there follows from it and is established by it that most widely accepted principle of philosophy—that actions belong to substances [actiones esse suppositorum]. And hence I hold it also to be true that this is a reciprocal proposition, so that not only is everything that acts an individual substance but also every individual substance acts without interruption, not excepting body itself, in which no absolute rest is ever to be found.[196]

10. But let us now consider a little more carefully the opinion of those who deny a true and proper activity to created things, as Robert Fludd, the author of the Mosaic Philosophy long ago did, and as some of the Cartesians now do who believe that things do not act but that God acts in the presence of things and according to the fitness of things, so that things are occasions, not causes, and merely receive but never effect or produce. While this doctrine had been proposed by Cordemoi, La Forge, and other Cartesians, it was particularly Malebranche, who, with his characteristic acumen, embellished it in luminous phrases.[197] But so far as I know, no one has given sound reasons for it. Certainly if this doctrine is extended so far as to deny even the immanent actions of substances—an interpretation which Mr. Sturm shows his conspicuous caution in rejecting, in his Elective Physics, Book I, chapter iv, Epilogue, Section 11—it seems foreign to reason as no other view can be. For who will doubt that the mind

thinks and wills, that many thoughts and volitions are produced in us and by us, and that there is something spontaneous about us? To doubt this would be to deny human freedom and to thrust the cause of evil back into God but also to contradict the testimony of our internal experience and consciousness, by which we feel that what these opponents have transferred to God without even the appearance of a reason belongs to ourselves. But if we ascribe to our mind an inherent force of producing immanent actions or, what is the same thing, of acting immanently, then nothing prevents the same force from residing in other souls or forms or, if you prefer, in the natures of other substances; indeed, it is entirely consistent for it to be so—unless it is believed that, in the nature of things which is open to us, our minds alone are active or that all power of action is immanently, and hence vitally, so to speak, coupled with the understanding. But such assertions are certainly not confirmed by any reason, nor can they be defended without coercing the truth. What we can establish about the external [transeunt] actions of creatures may better be explained elsewhere; in fact, I have already partly explained it—the intercourse of substances or of monads,[198] namely, arises not from an influence but from a consensus originating in their preformation by God, so that each one is adjusted to the outside while it follows the internal force and laws of its own nature. It is also in this that the union of soul and body consists.

11. It is indeed true, however, that bodies in themselves are inert if this is understood in the right sense, namely, insofar as what is once assumed for some reason to be at rest cannot impel itself to motion, or suffer being impelled by some other body without resistance, any more than it can of its own accord change the degree of velocity or the direction which it once has had or suffer such change from the outside easily and without resistance. So it must be admitted that extension, or the geometric nature of a body, taken alone contains nothing from which action and motion can arise. Indeed, matter rather resists being moved by its own

natural inertia, as Kepler has fittingly named it, and is thus not indifferent to rest and motion as it is popularly interpreted to be, but strives toward motion with an active force proportional to its magnitude. Hence it is in this passive force of resistance, which involves impenetrability but something more, that I locate the concept of *primary matter* or mass [*molis*], which is everywhere proportional in a body to its magnitude. And hence I show that far different laws of motion follow from it than would be the case if the body, or matter itself, possessed only impenetrability with extension. And just as there is a natural *inertia* opposed to motion in matter, so there is in the body itself, and, indeed, in every substance, a natural *constancy* opposed to *change*. This view does not justify those who deny action in things but rather opposes them, for as certain as it is that matter in itself does not begin motion, so certain is it also (as the well-known experiments on motion arising from the impact of a moving body also show) that, taken by itself, a body retains an impetus and remains constant in its speed or that it has a tendency to persevere in the series of changes which it has once begun. Now since these activities and entelechies cannot be modes of primary matter or of *mass*, which is something essentially passive, as the judicious Sturm has himself clearly recognized (as I shall show in the next paragraph), it can be concluded that there must be found in corporeal substance a *primary entelechy* or first recipient [πρῶτον δεκτικὸν] of activity, that is, a primitive motive force which, superadded to extension, or what is merely geometrical, and mass, or what is merely material, always acts indeed and yet is modified in various ways by the concourse of bodies, through a conatus or impetus. It is this substantial principle itself which is called the *soul* in living beings and *substantial form* in other beings, and inasmuch as it truly constitutes one substance with matter, or a unit in itself, it makes up what I call a monad. For if these true and real unities were dispensed with, only beings through aggregation would remain; indeed, it would follow that there would be left no true beings within bodies. For even though there are atoms of substance, namely, my monads, which lack parts, there are no atoms of mass or of minimum extension, or any last elements, since a continuum is not composed of points. Furthermore, there is no being that is greatest in mass or infinite in extension, even if there are always things greater than any given things; there is only a being greatest in intension of perfection or infinite in power.

12. I observe, however, that in his "Apologetic Dissertation" (chap. iv, Secs. 7 ff.) the famous Sturm has undertaken to combat a moving force resident in bodies by means of certain arguments. "I will show abundantly," he says, "that no corporeal substance is capable of any active moving power"—though I do not grasp what a power can be which is not actively motive. He says, however, that he will use twin arguments—one from the nature of matter and body, the other from the nature of motion. The former reduces to this: matter is by its nature an essentially passive substance, and so it is no more possible to give it an active force than for God to will a stone, while it remains a stone, to be alive and reasonable, that is, not to be a stone. In the next place, the things we assume in body are only modifications of matter, but a modification (this I admit is excellently expressed) of something essentially passive cannot make it something active. But to this it is easy to make the following reply from the point of view of the accepted as well as of the true philosophy. Matter may be understood as either secondary or primary. Secondary matter is indeed complete substance but not merely passive.[199] Primary matter is merely passive but not a complete substance; there must be added to it a soul or a form analogous to the soul—a first entelechy, that is, or a kind of nisus or primitive force of action which is itself the inherent law impressed upon it by divine command. I do not expect this famous and brilliant man to shrink back from this opinion, since he recently defended the view that body is composed of matter and spirit; except that spirit is not here to be taken for an intelligent being, as is usually done, but for a soul or a form analogous to the soul. Neither is it

to be taken for a simple modification but for something which perseveres and is constitutive and substantial. This I customarily call a monad, which contains perception and appetite, as it were. The accepted doctrine, which is consistent with Scholastic teaching favorably expounded, must therefore first be refuted if the argument of the famous man is to have force. Similarly, it is clear from this that we cannot concede his assumption that whatever is in a corporeal substance must be a modification of matter. For it is well known that according to the accepted philosophy there are souls in the bodies of living beings which are certainly no modifications of these bodies. For though the learned man may assert the contrary, and seem to deny to dumb animals all sensibility in any true sense, and a proper soul, he cannot assume this opinion as the basis of his demonstration until it has itself been demonstrated. I believe on the contrary that it is consistent neither with the order nor with the beauty or the reason of things that there should be something vital or immanently active only in a small part of matter, when it would imply greater perfection if it were in all. And even if dominant souls, and hence intelligent souls such as there are in men, cannot be everywhere, this is no objection to the view that there should everywhere be souls, or at least things analogous to souls.

13. The second argument, which the illustrious man takes from the nature of motion, seems to me to be no more necessarily conclusive than the first. Motion, he says, is merely the successive existence of the thing moved in different places. Let us concede this for the present, though it is not entirely satisfactory and expresses the result of motion rather than what we call its formal reason. However, it does not hereby exclude a moving force. For in the present moment of its motion, a body is not merely in a place of the same size as itself, but it also has a tendency or urge toward changing its place, so that its future state follows from its present one, per se, by the force of nature. Otherwise the body A which is in motion would be no different at the present moment (and therefore at any moment whatever) from the

body *B* which is at rest, and it would follow from the opinion of the distinguished man, if it is opposed to mine at this point, that there would be no way whatever of distinguishing between bodies, since there is no basis for such a distinction in a plenum of mass uniform in itself other than that which concerns motion. This view would thus also have the further effect that there could be absolutely no variation in bodies and that everything would always remain the same. For if there is no difference between any portion of matter and another portion equal and congruent to it (which the illustrious man must admit, since he has destroyed active forces or impetuses and all other qualities and modifications except for existence in this place and successively some future existence or other, all qualities and modifications having been removed), and, furthermore, if the state of this matter at one moment does not differ from its state at another moment except through the transposition of equal and congruent portions of matter which agree in everything, it obviously follows that, because of the perpetual substitution of indistinguishables, the state of the corporeal world can in no way be distinguished at different moments. For the *denomination* by which one part of matter is to be distinguished from another, that is, a future one, would be purely *extrinsic*, namely, that it will be in one place or another in the future. In the present there is in fact no distinction; indeed, neither can one be assumed with any ground in the future, because even in the future there will never be available any present distinction, since there will be no mark whatever by which one place can be distinguished from another or one part of matter from another in the same place (by the hypothesis of such a perfect uniformity in matter itself).

It would also be vain to have recourse to *figure* in addition to motion. For in a perfectly similar, undifferentiated, and filled mass there can arise no shape or limitation or distinction of different parts, except through motion itself. If therefore motion contains no distinguishing mark, it can also bestow none upon figure, and since everything which is substituted for a prior thing must be perfectly equivalent to it, no observer, not even an omniscient one, will see even the smallest indication of a change. And so everything will be the same as if no change or differentiation had taken place in the bodies, and no reason can be given for the diverse appearances which we experience by sense.[200] This would be as if we assumed two perfect concentric spheres perfectly similar, each to the other as wholes as well as in their parts, the one included in the other so that not even the slightest gap existed; then if we assumed the included sphere to revolve or to be at rest, not even an angel (not to say more) could observe a distinction between the states of the two spheres at different times or have any criterion by which to distinguish whether the included sphere is at rest or turning, and according to what law of motion. In fact, not even a boundary between the different spheres could be defined because of the lack, at the same time, of a *gap* and a *difference*, just as the motion could not be recognized, solely because of the lack of a *difference*. Hence we must hold it for certain—even if those who have not penetrated sufficiently deeply into these matters may not perceive it—that such things are foreign to the nature and order of things and that *there is no perfect similarity anywhere*; this is one of my new and most important axioms. A consequence of this is also that there are to be found in nature no corpuscles of extreme hardness, no fluids of greatest thinness, no universally diffused subtle matter, no ultimate elements such as some thinkers call primary and secondary.[201] It is because Aristotle had seen something of these principles, I believe, that he concluded (he being in my opinion more profound than many people think) that there is needed some alteration besides change in place, and that matter is not similar to itself everywhere and does not remain invariable. But this dissimilarity or diversity of qualities, and this ἀλλοίωσις or alteration, which Aristotle did not adequately explain, come from the different degrees and directions of the impulses and therefore from the modifications existing within the monads themselves. I think we understand further from these considerations that something must necessarily be assumed in bodies other than a uniform mass and its transportation—which certainly changes nothing. Of course those who hold to *atoms* and a *vacuum* at least diversify matter somewhat, by making it divisible in one place, indivisible in another, full in one place, with intervening spaces in another. But a long time ago, after ridding myself of youthful prejudices, I saw that we must reject atoms and a vacuum. The famous man adds that the existence of matter through different moments of time is to be ascribed to the divine will; why not then, he asks, also ascribe to the same being the fact that it exists here and now? I reply that this is undoubtedly due to God, as are all other things insofar as they involve some degree of perfection. But just as that first and universal cause which conserves all things does not destroy but rather supports the natural permanence of a thing which comes into existence and the perseverance in existence once bestowed upon it, so this same cause will not destroy, but rather confirm, the natural efficacy of a thing which is set in motion, and the perseverance in action once impressed upon it.

14. Many other things appear in this "Apologetic Dissertation" which involve difficulties; for instance, what he says in the chapter (chap. iv, Sec. 11) about a moving globe being translated through many intermediate positions into collision with another globe—to the effect that the last globe is moved with the same force by which the first is moved. Here it seems to me that they are moved with equivalent forces, but not with the same force, since each one is set in motion by *its own force*, namely, by elastic force, when driven back by the body striking it, though this may seem remarkable. (I am not now discussing the cause of this elasticity, nor do I deny that it must be explained mechanically by the motion of a fluid existing in and moving through it.) His remark in Section 12, that a thing which cannot give itself original motion cannot continue its motion by itself, will therefore also rightly seem strange. For it is clear that, on the contrary, as force is necessary to impart motion, so, once the impulse is imparted, far from being needed

to continue this motion, it is rather needed to stop it. Such conservation is made necessary in things by a universal cause, which this is not the place to discuss, but which, as I have already cautioned, would destroy the substance of things if it destroyed their efficacy.

15. These considerations make it clear, further, that the doctrine of occasional causes which some defend (unless it is interpreted in a way that makes possible some moderations, as Sturm has partly admitted and partly seems to want to admit) is fraught with dangerous consequences, even if its learned defenders do not, as is undoubtedly true, intend them. So far is this doctrine from increasing the glory of God by removing the idol of nature that it seems rather, like Spinoza, to make out of God the nature of the world itself, by causing created things to disappear into mere modifications of the one divine substance, since that which does not act, which lacks active force, and which is despoiled of all distinctiveness and even of all reason and ground for subsistence can in no way be a substance. I am most certainly convinced that Mr. Sturm, a man distinguished in piety and learning, is far removed from such monstrosities. So there is no doubt that he will either show clearly on what ground any substance or even any change is left in things, according to his doctrine, or he will extend his hand to the truth.

16. There are many things, in fact, which make me suspect all the more that I have failed adequately to understand his opinion, and he mine. He has somewhere admitted to me that a certain particle of the divine power can, and indeed must, be understood in a sense as belonging to and attributed to things. (In my opinion such a particle must be an expression, an imitation, a proximate effect of the divine power, for this power itself cannot be cut up into parts in any case.) This is shown in his letters to me and repeated in the passage of the *Elective Physics* cited at the beginning of this paper. If, as appears from his words, this is to be understood in the sense in which we call the soul a part of the divine breath, the controversy between us at this point is already ended. But I hesitate the more to affirm that this is what he means, because I do not see him say-

ing anything of this sort elsewhere or expounding any consequences from this view. On the contrary, I observe that his other remarks have very little coherence with this opinion, while the "Apologetic Dissertation" leads to entirely different conclusions. It is true that when my opinions on an inherent force were first published in the Leipzig Acta eruditorum of March, 1694, and further elaborated in my Specimen dynamicum in the same journal for April, 1695,[202] he raised certain objections in a letter and, after receiving my reply, generously said that there was no difference between us except in our way of speaking. But when I commented on this and still raised several issues, he turned about and pointed out many differences between us, which I acknowledge. These had hardly been uncovered, however, when it occurred to him again, very recently, to write me that except for a difference in terms there is no difference between us. This would be most pleasing to me. I have therefore tried, on the occasion of this latest "Apologetic Dissertation," to explain the matter so that our individual opinions and their truth can at length be established more easily. For this distinguished man possesses great ingenuity of insight and keenness in exposition, so that I hope his study will throw no small light upon our problem and that my work will not prove useless because it has provided him an occasion for weighing and throwing light with his customary industry and force of judgment upon important aspects of the present discussion which have so far been overlooked by other authors and myself. Thus these considerations will be supplemented by new, more profound, and more widely extended axioms, from which there can sometime come a restored and revised system of philosophy midway between the formal and the material but rightly combining and preserving both.

PART IV

HANOVER UNDER GEORGE LOUIS

1698—1716

54

Correspondence with John Bernoulli

1698-99

The Bernoulli brothers, John and James (the nephew Daniel had not yet come on the scientific scene), were among Europe's outstanding mathematicians and among the first to champion Leibniz's new infinitesimal analysis. They had entered into the solution of the great test problems of the 1690's in keen, jealous rivalry with each other as well as with other scientists—John at Groningen, James at Bern. Leibniz's correspondence with both was extensive but chiefly mathematical and physical in content. Near the end of the century a three-cornered exchange developed between Leibniz, John Bernoulli, and Burcher de Volder (No. 55) in which certain issues connected with the nature of matter and the infinite were discussed.

Earlier in 1698 Leibniz had suggested that the infinites and infinitesimals of his calculus are "imaginary, yet fitted for determining reals, as are imaginary roots. They have their place in the ideal reasons by which things are ruled as by laws, even though they have no existence in the parts of matter." He suggested also that "the real infinite is perhaps the absolute itself, which is not made up of parts but which includes beings having parts, in an eminent way and in proportion to the degree of their perfection" (June 7, 1698; GM., III, 499-500).[203] The following letter summarizes the discussion about this point. The mathematical portions, concerned primarily with the solution of the catenary, are omitted.

* * *

I

[GM., III, 551-53]

Hanover, November 18, 1698

. . . You say that my discussions of more metaphysical matters are entirely too laconic, but I took pains, I believe, to speak accurately and fully. If there remain some doubts, however, I shall try to satisfy you by replying to them. You say that I have given definitions rather than explanations. But would that definitions might always be given, for they virtually contain the explanations! As concerns infinitesimal terms, it seems to me not only that we cannot penetrate to them but that there are none in nature, that is, that they are not possible. Otherwise, as I have already said, I admit that, if I could concede their possibility, I should concede their being.[204] We must see, therefore, what reason can be used to demonstrate that a straight line, for example, is possible which is infinite yet terminated on both ends. But I come to your points.

On 1. When I said that primary matter is that which is merely passive and separated from souls or forms, I said the same thing twice, for it would be the same if I had said that it is merely passive and separate from all activity. Forms are for me nothing but activities or entelechies, and substantial forms are the primary entelechies.

On 2. I have preferred to say that the active is incomplete without the passive, and the passive without the active, rather than to speak of matter without form and form without matter, in order to use terms already explained rather than terms still to be explained—and also somehow to apply your advice before you give it, for our moderns will popularly take less offense at the term "activities" than at that of "forms."

On 3. We need not be stopped by the fact that the Cartesians deny anything in the body analogous to the soul, for they have no reasons for denying it, and it does not follow that a thing has no being merely because we cannot have a sensory image of it.

On 4. It has long seemed ridiculous to me that the nature of the universe should be so niggardly or grudging that it has provided souls only to such insignificant masses as the human bodies on this earth of ours, when it could have provided them to all bodies without interfering with its other goals.

On 5. How far a piece of flint must be divided in order to arrive at organic bodies and hence at monads, I do not know. But it is easy to see that our ignorance in these things does not at all prejudice the matter itself.

On 6. I do not believe that there is any minimal animal or living being, that there is any without an organic body, or any whose body is not further divisible into more substances. Therefore we never arrive at living points or points endowed with forms.

If you have a clear idea of the soul, you will also have one of forms, for they are the same genus but different species.

You are right in concluding that we ought not to reject something merely because we do not perceive it clearly and distinctly. No matter how much the good Cartesians talk about their clear and distinct perceptions, they do not seem to me to perceive even extension in this way.

For the rest, if we conceive of soul or form as the primary activity, from whose modifications the secondary forces arise as figures arise from the modifications of extension, I believe we shall have satisfied the demands of understanding.[205] There can be, that is, no active modifications of something whose essence is purely passive, because modifications limit rather than increase or add. Hence we must assume, besides extension, which is the seat or the principle of figures, a seat or first bearer [proton dektikon][206] of actions, namely, soul, form, life, primary entelechy, or whatever you wish to call it.

I approve thoroughly of your advice that we should refrain from mentioning primary matter and substantial forms in our discussions with Cartesians and similar people and content ourselves with mentioning only passive mass in itself and entelechy or primary activity, soul, or life.

You are also entirely right in thinking that all the bodies in the world arise from an interaction of internal forces, and I have no doubt that these forces are coeval with matter itself, for I believe that matter cannot subsist in itself without forces. I think, nevertheless, that primary or living entelechies are different from dead forces, which themselves probably always arise from living forces, as is apparent when a centrifugal tendency, which must be considered a dead force, arises from the living force causing rotation. Life, or the first entelechy, is something more than any simple dead tendency, for I believe it includes also perception and appetite, both corresponding to the present state of the organs in an animal.

Your discussion is in full agreement with my opinion, and you confirm my principle that changes do not occur by a leap. Besides, it is no jest, but a firm conviction of mine, that there are animals in the world as much greater than ours as ours are greater than the animalcules of the microscope. Nature knows no limits. And so it is possible, on the other hand—indeed, it is necessary—that there should be worlds not inferior to our own in beauty and variety, in the smallest bits of dust, in fact, in atoms. And though this may seem even more wonderful, nothing prevents animals from passing over into such worlds when they die. For I am of the opinion that death is nothing but the contraction of an animal, as generation is nothing but its unfolding [evolutio].

It was my opinion long before Newton's work, that gravity is inversely proportional to the square of the distance, a theory at which I arrived not merely by a posteriori processes but also by an a priori reason, which I am surprised that he did not notice. Leaving out of consideration the physical basis of gravity, namely, and remaining within mathematical concepts, I consider gravity as an attraction caused by certain radii or attractive lines going out from an attracting center; so, like the density of illumination in rays of light, the density of radiation in gravitational attraction will be inversely proportional to the square of the distance from the radiant point. . . .

II

[GM., III, 574-75]

February 21, 1699

. . . Possible things are those which do not imply a contradiction; actual things are nothing but the best of possibles, everything considered. And so things that are less perfect are not therefore impossible, for we must distinguish between the things which God can do and those which he wills to do; he can do all things, but he wills the best. When I say that God elects out of infinite possibilities, I mean the same as you when you say that he has elected from eternity. Your remark that it is impossible for him to revoke his decisions and then to create other things than those he has decided to create, pertains to hypothetical necessity, which we are not discussing here.

I know that, as you imply, there are many who doubt that we can know what conforms to the divine wisdom and justice. Yet I believe that, just as our geometry and our arithmetic are true for God as well, so general laws of the good and the just, of mathematical certainty, are also valid for God. And even if evil in itself is less than nothing, it sometimes increases reality when conjoined to other things, as shadows are useful in pictures and dissonances in music. I have no doubt that evil is allowed when a greater good grows from it.

It is most pleasing that my opinion about the union and intercourse between soul and body does not conflict with the view which you and Mr. Braun hold. But those who hold the problem to be so far inexplicable and miraculous, as it were, do not seem to have understood my view sufficiently, for, if I am not mistaken, every difficulty is met in it. My reply to two objections which seemed of great importance to you has not displeased Mr. Bayle. Even if the soul does not consist of parts, yet in its perceptions it expresses a thing consisting of parts, namely, the body. Since it has many perceptions at the same time, therefore, and future consequences arise naturally from present perceptions, it is not strange that so many modifications flow spontaneously from the soul. There is also no doubt that our future states are already in some way involved in our present ones, though they cannot be distinguished because of the multitude and smallness of the perceptions occurring at the same time. I have sent this and other matters to Bayle in letters, and Mr. Basnage promised to insert my reply in his last quarterly review, issued in the fall of last year, if I am not mistaken.[207] . . .

In your exposition of my theory about the subject matter of entelechies there are some things which I should not venture to affirm as you do. For in those matters where certainty can be had, I do not like to use hypotheses, yet it is sufficient to consider the whole of the matter. To your objections I should make this reply. When I say that the moment of death cannot be defined, I at once signify that in a metaphysical sense there is no such moment; nor do I see that it destroys the law of continuity to say that somehow a great change takes place in this very short time. It is quite consistent for such a thing to happen in nature, especially in deaths. For it happens that composite machines are slowly formed but easily destroyed. Yet the wisdom of the Author of the universe brings it about that what is best for the world as a whole is always considered. In this theater it is possible for the same animal to be produced more than once, yet I believe that the contrary is also possible. Reason does not determine this question very easily, therefore, and I hold it for a deeper investigation.

You do not reply to the reason which I have proposed for the view that, given infinitely many terms, it does not follow that there must also be an infinitesimal term. This reason is that we can conceive an infinite series consisting merely of finite terms or of terms ordered in a decreasing geometric progression. I concede the infinite plurality of terms, but this plurality itself does not constitute a number or a single whole. It means nothing, in fact, but that there are more terms than can be designated by a number. Just so there is a plurality or a complex of all numbers, but this plurality is not a number or a single whole. . . .

55

Correspondence with De Volder

1699-1706

Burcher de Volder (1643-1709) held the professorships of philosophy, physics, and mathematics in the University of Leyden. Highly esteemed by his contemporaries, appointed as his literary executor by his fellow-countryman Huygens, he was excellently qualified to test the consistency and clarity of Leibniz's philosophical analyses. Though considered a Cartesian, he had shown independence of judgment in examining Descartes's physics and metaphysics.

De Volder was brought into correspondence with Leibniz through a criticism of the calculus which he offered to John Bernoulli. He took issue also, from a Cartesian viewpoint, with Leibniz's theory of the conservation of force and with his conviction that an elastic force must be assumed in bodies in addition to extension and impenetrability. Referred by Bernoulli to Leibniz, these objections called forth a metaphysical justification of the conservation of force and therefore a development of the notion of substance. At first Leibniz's letters, of which only the most important are here translated, show a reluctance to discuss his still unperfected concept of substance and express his feeling that his own efforts are hypothetical and incomplete and should be a part of a co-operative enterprise. Eventually, however, his letters reveal irritation at De Volder's persistence, and he finally affirms his own dynamic idealism as against the latter's realism.

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I

[G., II, 168-75]

Hanover, March 24/April 3, 1699

No more outstanding example could easily have been given, both of your very penetrating judgment and of your uncommon love of truth, than that which you have given me in your excellent and most friendly letter. I wish my capacity were as great as my will to do justice to it. But *est aliquid prodire tenus*;[208] what is not yet ready to be defended by rigorous demonstrations will meanwhile commend itself as a hypothesis which is clear and beautifully consistent within itself and with phenomena. I believe also that, to anyone who considers it attentively, most of it will seem certain.

This is the axiom that I use—*no transition is made through a leap*. I hold that this follows from the law of order and rests upon the same reason by which everyone knows that motion does not occur in a leap; that is, that a body can move from one place to another only through intervening positions. I admit that, once we have assumed that the Author of things has willed continuity of motion, this itself will exclude the possibility of leaps. But how can we prove that he has willed this, except through experience or by reason of order? For since all things happen by the perpetual production of God, or, as they say, by continuous creation, why could he not have transcreated a body, so to speak, from one place to another distant place, leaving behind a gap either in time or in space; producing a body at *A*, for example, and then forthwith at *B*, etc.? Experience teaches us that this does not happen, but the principle of order proves it too, according to which, *the more we analyze things, the more they satisfy our intellect*. This is not true of leaps, for here analysis leads us to mysteries [ἄρρητα]. Thus I believe that the same thing applies not only in transitions from place to place but also in transitions from one form to another or from one state to another. For experience, as well, refutes all changes through a leap. And I do not believe that any reason a priori can be given against a leap from place to place which is not also effective against a leap from state to state. . . .

. . . I do not think that substance is constituted by extension alone, since the concept of extension is incomplete. Nor do I think that extension can be conceived in itself, but I consider it an analyzable and relative concept, for it can be resolved into plurality, continuity, and coexistence or the existence of parts at one and the same time. Plurality is also contained in number, and continuity also in time and motion; coexistence really applies to extension only. But it would appear from this that something must always be assumed which is continuous or diffused, such as the white in milk, the color, ductility, and weight in gold, and resistance in matter.[209] For, by itself, continuity (for extension is nothing but simultaneous continuity) no more constitutes substance than does multitude or number, where something is necessary to be numbered, repeated, and continued. So I believe that our thinking is completed and ended in the concept of force rather than in that of extension. And we need seek no other concept of power or force than that it is the attribute from which change arises, and whose subject is substance itself. I do not see anything here which escapes the understanding. The nature of the matter does not allow anything more explicit, such as a picture. I think that the extended has a unity only in an abstract sense, namely, when we leave out of consideration the internal motion of the parts, for each part of matter is itself subdivided further into actually different parts; this the plenitude does not at all prevent. Nor are the parts of matter different only in their modes, if they are distinguishable from each other by the souls and entelechies which subsist always.

Somewhere in his letters I have observed that Descartes too, following Kepler's example, has acknowledged that there is inertia in matter.[210] This you derive from the power which you say everything has to remain in its own state and which is not different from the nature of that thing itself. So, you believe, the simple concept of extension suffices to explain this phenomenon too. But the axiom that a body conserves its own state needs itself to be changed, for a body moving in a curve, for example, does not conserve its curvilinear path but only its direction. But granted that there is in matter a force to maintain its state, this force can certainly not be derived in any way from extension alone. I admit that each thing remains in its state unless there is a reason for change; this is the principle of metaphysical necessity. But it is one thing to retain its state until there is something which changes it, which this may do even though it is in itself indifferent to either state; it is another and far more significant matter if a thing is not indifferent to change but has a force and an inclination, as it were, to retain its state and so to resist motion. Thus in a book written long ago when I was young, I proceeded on the assumption that matter in itself is indifferent to motion and rest and concluded from this that the largest body, at rest, must be moved by any impelling body, however small, without any weakening of the latter; from this I then derived the abstract rules of motion for the system.[211] And such a world, in which matter at rest would obey the moving body without any resistance, could indeed be imagined as possible, but such a world would actually be pure chaos. So the two tests upon which I always depend—success in experiment and the principle of order—caused me later to recognize that matter has been so created by God that there inheres in it a certain repugnance to motion and, to put it in a word, a resistance, insofar as the body in itself withstands being moved and thus opposes all motion if at rest, or all greater motive force applied in the same direction if in motion, so that it weakens the force of the impelling body. Since matter in itself therefore resists motion by a general passive force of resistance but is set in motion by a special force of action, or entelechy, it follows that inertia also constantly resists the entelechy or motive force during its motion. Hence I showed in the preceding letter that the united force is stronger, or that the force is twice as great if two degrees of speed are combined in 1 pound, than if they are dispersed through 2 pounds, and that the force of 1 pound moved at double velocity is therefore twice as great as that of 2 pounds moved at the simple velocity, because, though the quantity of velocity is the same in both cases, the inertia of matter offers only half the resistance in the case of 1 pound. This inequality in forces which exists between 1 pound and 2, with a velocity inversely reciprocal to their masses, has been demonstrated in another way from our measurement of forces, but it is also nicely demonstrable from this consideration of inertia, so completely is everything in agreement. Thus the resistance of matter contains two factors: impenetrability, or antitypy, and resistance, or inertia. And since these two factors are everywhere equal in a body or are proportional to its extension, it is in them that I locate the nature of the passive principle or of matter, even as I recognize, in the active force which exerts itself in various ways through motion, the primitive entelechy or, in a word, something analogous to the soul, whose nature consists in a certain perpetual law of the same series of changes through which it runs unhindered. We cannot dispense with this active principle or ground of activity, for accidental or changing active forces and their motions are themselves certain modifications of some substantial thing, but forces and actions cannot be modifications of a merely passive thing such as matter. It follows, therefore, that there is a primary active or substantial being which is modified by an added disposition of matter or of passivity. Hence secondary or motive forces and motion itself must be ascribed to a secondary matter or to the complete body which results from the active and the passive together.

And so I come to the communication between the soul or entelechy of the organic body and the mechanism of its organs. I am happy that my hypothesis about this does not entirely displease a man of your acumen and discernment. You make it very clear, in fact, when you ascribe an adequate idea of the corporeal mechanism to the soul; this is just what I mean when I say that it is the nature of the soul to represent the body. Therefore whatever follows from the laws of body must necessarily be represented in order by the soul to itself, some of it distinctly but some confusedly (that, namely, in which a multitude of bodies is involved). In the former case, the soul understands; in the latter, it senses. Meanwhile, I think that you agree with me that the soul is one thing, and the idea of the body another, for the soul remains the same, but the idea of the body changes as the body itself changes, whose present modifications it always reveals. Of course the idea of the present state of the body is always in the soul, but it is not simple and hence not purely passive but is combined with a tendency toward a new idea arising out of the earlier one, so that the soul is the source and foundation of different ideas of the same body, which arise according to a prescribed law. But if you take the term "adequate idea" to mean not that which changes but the constant law of change itself, I have no objection; in this sense I will say that there is in the soul an idea of the body and also the phenomena which proceed from it.

For the rest, there are in all of these matters certain things which should be discussed more thoroughly, which I shall not fail to do when occasion offers. For even though I cannot easily demonstrate everything a priori with geometric rigor, or give accurate explanations even where I see the reasons, I yet venture to promise that no objection can be offered which I shall be unable to satisfy. This in itself is, I believe, not to be disdained in matters so far removed from sense, especially since the agreement of scientific teachings, both with phenomena and among themselves, is among the most powerful tests of their truth. Objections which have any weight always serve to clarify the nature of any issue, and so I recognize how very much I and all lovers of truth are indebted to you, for I feel that you kindle such a light for me that I seem to understand my own ideas better by reading yours. If by your aid, and that of the Bernoullis and other men like them (would there were not so very few of them), I shall sometime be able to succeed in supporting with clear demonstrations what I can now only defend in one way or another—I shall not begrudge to others my light which I owe in great part to you. At least I shall dread the opinions of others the less for having relied upon your judgment.[212] . . .

II

[In his reply of May 13, 1699, De Volder attacked Leibniz's analysis of substance as complex and insisted upon a return to a "logical" approach to the problem instead of the physical and metaphysical ones. We have the idea of a substance, he held, only if we have a simple concept from which no essential can be removed without destroying the entire concept. Extension is such a concept; change, motion, and force are not. The concept of "a subject of change" is a purely formal designation which throws no light on the nature of such substance, as extension does, for example, upon its accident, motion.]

[G., II, 182-85][213]

Hanover, June 23, 1699

. . . Your statements about the concept of substance are as usual subtle and ingenious. It is within the arbitrary choice of anyone to assign names to concepts, yet concepts thus named do not always correspond either to actually existing things or even to accepted usage.

You assert that the notion of substance is formed out of concepts and not out of things. But are not concepts themselves formed from things? You say that the notion of substance is a concept of the mind, or a rational entity, as they say. But the same can be said of any concept, if I am not mistaken, and, furthermore, it is not about concepts but about the objects of concepts that we say entities are either real or rational. But substance, I believe, is a real entity—indeed, the most real. You say there are two kinds of concepts, some representing a single unified something from which nothing can be separated without destroying the whole; in your opinion this is the concept of a substance, and you say that extension is such a concept. The other kind of concept may represent two or more things. This is a little obscure to me. Surely every concept or definition is such that you cannot remove anything without destroying the whole definition; yet in that case another concept may come into being in the definition. Thus if you remove the concept of equal sides from the definition of a square, the square is destroyed but a rectangle remains. A concept from which nothing can be removed must be simple and primitive, but I do not think that the concept of substance should be established in this way or that the concept of extension is of this kind. Furthermore, you say that those "two or more things" are so related to each other that one can be conceived without the other, and so perception and extension are thus related that neither involves the other; extension is involved in motion but not the contrary. And motion is thus an accident or mode. In all these things I hold very different opinions. I believe that perception is involved in extension, and motion as well, and that substance and accident equally involve and are involved in each other. Extension is an attribute; the extended, or matter, is not substance but substances. Moreover, duration, particular time, and the enduring thing are in a ratio, on the one hand, proportional to extension, place, and the placed thing, on the other. It does not seem that there can be things which do not have common attributes.[214] Nor should I think that the concept of extension is primitive, or one from which nothing can be withdrawn, since it may be analyzed into plurality, which it has in common with number; into continuity, which it has in common with time; and into coexistence in common even with things that are not extended. I should not have believed that plurality is to be denied in the extended thing, especially if we admit that it has actual parts; we should in that case also have to deny plurality to a herd or army, in other words, everywhere. Continuity in motion is distinct from continuity of place, for it contains continuity both of time and of variation in degree of velocity. Time is neither more nor less a rational entity than space. To coexist and to exist before or after are something real; they would not be, I admit, as matter and substances are commonly understood. But it is easier to show what these concepts are not than to explain in words what they are and to prove it with reasons.

You say that a subject of change is merely a logical concept; but it is enough that it is true, though you could just as well have called it metaphysical. We despise obvious things, yet the unobvious things sometimes follow from them. We must start with nominal definitions, and it is of such a definition that I spoke when I said that no other definition of power is needed than the one I had advanced. The other consideration then becomes the causal one of how change takes place. And here there can be things which escape our understanding. You say that the unity of an extended thing is perceived even if it is divided into parts moved in different ways, since one of these parts can neither exist nor be conceived without the others. Therefore you assume two things which I cannot concede: that one part of an extended thing cannot exist or be conceived without the others and, then, that such things form a unity. From this you show that a vacuum is impossible. But your arguments do not achieve this, and, if it be conceded, it follows indeed that one part of matter cannot exist without some other part, but it hardly follows that it cannot exist without these particular others. Besides, unless I am deceived, this argument proves too much, for according to it things removed from each other would still be one. As I understand unity, such things are more properly to be called many, and they do not constitute a unity except as an aggregate while they are grasped together in one thought. In what is truly one substance there are not many substances. I recognize neither inertia nor motion in extension;

in extended matter I recognize both, but not by reason of its extension.

You very rightly observe, in agreement with my own opinion, that it is in opposition to the laws of power, cause, and effect, for a great body to be moved by a smaller without penalty. But from this fact I prove that the body contains something dynamic by virtue of which the laws of power are observed. It therefore contains something besides extension and antitypy, for no such thing can be proved from these two alone. I made this same reply to someone in the Parisian journal many years ago. I recognize that resistance involves something besides passivity, that secondary motive forces are not modifications of something merely passive, and that there must therefore be an active substantial principle. This I have thought it worth while to point out for the sake of those who do not yet hold that all substance is active. I think that an extended substance completely at rest belongs among those things of which we cannot form a distinct concept, like a most rapid motion.

You ask, Sir, whether in my judgment "the active principle is extension, or a mode of extension, or a substance distinct from extension." I reply that the principle seems to me to be substantial, and constitutive of the extended itself or of matter, that is, of the thing which possesses not only extension and antitypy but also action and resistance. Extension is itself, for me, an attribute resulting from many substances existing continuously at the same time. So primitive force can be neither extension nor a mode of it. Nor does it act upon extension but in the extended. When you ask further if an inanimate body has its own entelechies "distinct from the soul," I reply that it has innumerable such entelechies, since it consists in turn of parts each of which is animated or as if animated. In the soul there is an adequate idea of matter, yet the soul is not, for me, the idea of matter itself but the source of ideas for itself and in itself—ideas born of its own nature but representing the different states of matter in order. An idea is, so to speak, something dead and unchangeable in itself, as is a figure; soul is rather something living and full of activity; and in this sense I do not say that it is any one idea which tends to change out of itself, but only various ideas succeeding each other, one of which can, however, be derived from another. But in another sense of the word, I could say that in some way the soul is a living or substantial idea or, more correctly, that it is an "ideating" substance. Nor do I think that you intend anything else when you say that ideas act upon each other in representing each other, for I do not believe that you regard ideas as substances colliding with each other as do bodies. . . .

These are the answers, illustrious Sir, which I thought could be made. I wish that they could all be explained more distinctly and proved more soundly, but in this infancy of our philosophy it is something to point out what seems to be irrefutable, and to derive the rest from hypotheses which are few in number and worthy of respect. Perhaps there will be a time when we can go further, especially if I continue to gather rays from your light.

III

[Instead of the above letter Leibniz sent a much shorter one. De Volder's reply of August 1, 1699, returned to the principle of the conservation of force and particularly to the problem of continuity raised in an earlier letter (No. 1), in which Leibniz asserted that no a priori argument could be given for continuous motion. Leibniz's reply, undated but in 1699, once more summarized these problems.]

[G., II, 192-95]

. . . For the rest, to mention a few other matters, you asked me to prove a priori the law of the continuity of changes; I replied that a proof a priori might with equal right be demanded of the law of the continuity of motion. You offered a reason based on direction, on the fact, namely, that moving bodies always adopt a straight line. To this I replied that I did not see that the conclusion follows, for a cause which translates bodies anywhere by a leap could still act in such a way as to translate them always in a straight line. So, unless I am mistaken, you would still have to show that this is impossible, in order to make your proof absolute. I added the hypothesis of transcreation for the sake of illustration, speaking philosophically and particularly like the Cartesians, who say, with some ground, that God creates all things continuously.[215] For them, therefore, moving a body is nothing but reproducing it in successively different places, and it would have to be shown that this reproduction cannot take place in leaps. Rather, this could not be shown without returning to the reason which I have proposed for the universal law of continuity. If you do not accept such a re-creation of things, however, the same thing must be said regardless of what the cause of motion may be. Then, too, one can, in replying to an opponent, assume a hypothesis which he does not accept, until the hypothesis has been refuted. You are right in saying that an interruption of motion is inconsistent both with the velocity and with the direction of motion, once you assume, that is, that motion is something continuous in nature. But anyone who rejects continuity in things will say that motion in its essence is nothing but a succession of leaps through intervening intervals, which flow from the action of God and not from the nature of the thing moved, or which are re-creations by God in separate places. His philosophizing will then be almost like that which would compound matter out of mere discrete points and would support this opinion on the ground of the labyrinthine difficulties which surround the nature of continuity, from which there do indeed follow, not the necessity of leaps, but some other things which are not usually well understood. However, this hypothesis of leaps cannot be refuted except by the principle of order, with the aid of the supreme reason, which does everything in the most perfect way.

Since every extended body, as it is really found in the world, is in fact like an army of creatures, or a herd, or a place of confluence, like a cheese filled with worms, a connection between the parts of a body is no more necessary than is a connection between the parts of an army.[216] And just as some soldiers can be replaced by others in an army, so some parts can be replaced by others in every extended body. Thus no part has a necessary connection with any other part, even though it is true of matter in general that, when any part is removed, it must necessarily be replaced by some other part, just as it is necessary, when soldiers are confined in a small inclosure or one which will not hold many, for another to take the place of anyone who goes out. I have already made enough suggestions about this in my previous letter, and I do not see any point that can be made about any body whatsoever, apart from the soul, which would not be equally valid for an army or a machine. Therefore I understand a true unit (and not merely a sensible one), or a monad, to exist only where there is something which does not contain many substances.

I too ascribe to motion (including in this the causes of motion) every variety of bodies, yet I recognize a substantial distinction between the parts of matter. All others also recognize this who assign a rational soul to man as something substantial but without extension, though they do not always admit such a mind in all the parts of matter as well.

You seem to designate as logical or metaphysical those concepts which explain nothing, but I do not recognize such as concepts at all. So far is the concept which I proposed from explaining nothing, however, that I think that proofs of great importance can be derived from it and from notions similar to it. But we are constituted so full of preconceptions that, although we properly distinguish intelligible things from those given in sense perception theoretically, so to speak, and declare that we distinguish them, we do not observe the distinction in practice and regard almost as nothing everything which is not to be grasped in images.

In no other way can I take what you say about not being able to understand the things I asserted about an active principle prior to extension; you mean that you are unable to imagine them. Meanwhile, if an opinion follows necessarily from premises that are understood, we may consider it itself to be understood. If I am not mistaken, you certainly understand something when the Cartesians speak of the human soul, which I do not consider different in kind from other entelechies. To your first question (what this active principle may be) I must therefore give the same answer as to the question of what the soul may be, though I might also make a somewhat more distinct reply. Incidentally, it seems that the power of preconception and authority is so great that many people have convinced themselves that they understand in Descartes what they deny they understand in others. If you interpret your second question (whether a living body has an entelechy distinct from the soul) in such a way that it applies to the living body as a whole and not to its separately animated parts, I reply that such a body does not have any other entelechy except the soul and the entelechies of its separately activated parts. Indeed, there would be no such soul of the whole, aside from the soul of each separately animated part, if the soul did not dominate the whole by virtue of the structure of that whole.

When you say that more causality or force is needed to move a larger body at a given velocity than to move a smaller one at the same velocity, you are already tacitly assuming that the body resists motion. For if it does not, but is indifferent and in a state of equilibrium, as it were, I do not see what obstacle its magnitude can offer to an impelling force, for no resistance can ever arise from an increase of such indifferent masses. And likewise, if it is unnecessary to pass through intervening stages, then any cause or impulsion to motion whatever, which inclines or determines a body to a given velocity and direction, will be enough, and hence any moving body, however small, will be sufficient to carry with it any body, however large, without resistance or impediment to its own motion. Since this does not happen, but rather the contrary, namely, that a greater force must be expended and consumed to produce the motion of a larger body, we must understand that matter resists motion. Hence bodies also suffer compression before they allow themselves to be carried away; therefore, the law of continuity is always obeyed in changes, and no greater motion can be produced except by passing through the lesser stages of motion.

If the entelechy is entirely different from extension, you infer from this that it can do nothing to extension. But does not motion differ from extension? Yet it can do something to it. Accurately speaking, moreover, extension is merely something modal like number and time, and not a thing, since it is an abstract designation of the continuous possible plurality of coexisting things, while matter is in fact this very plurality of things itself and hence an aggregate of the things which contain entelechies. So I do not admit an entelechy entirely separated from matter, if by the word "extension" you mean matter in this sense. Finally, it means nothing in metaphysical rigor for one thing to do something to another, except that one thing responds spontaneously to the other—as we have already agreed in the case of the intercourse between soul and body.

Do not apologize for your dissent, for such things are not matters of choice. The pursuit of truth, care in investigation, and candor combined with moderation in speech—these should be enough for us, nor can they be anything but useful and pleasing to men of good will.

P.S. From our friend Bernoulli I have learned that you find it more important to throw light upon the activity of substance than to estimate forces. I believe the same thing and approve your judgment. Yet it has always seemed to me that the latter question is the gateway through which to pass to the true metaphysics, since the mind is surely gradually freed from the false notions of matter, motion, and corporeal substance which are held popularly and by the Cartesians, when it comes to understand that the rules of force and action cannot be derived from these notions and that we must either take refuge in a deus ex machina or hold that there is something higher in bodies themselves. If the mind is led without preparation into this holy of holies, where it can suddenly view the entirely novel nature of substance and body fully and from the beginning, we must fear that it will be blinded by the very abundance of light.

IV

[Leibniz's efforts to sharpen his own analysis had little effect on De Volder, who in his reply returned to his own definition of substance as that which is conceived in itself as a simple idea from which nothing can be removed without destroying it. In his letter of February 13, 1701 (G., II, 223), he went so far as to call the idea of substance a modus concipiendi independent of all attributes and repeated his challenge to Leibniz to develop his own idea further.]

[G., II, 224-28]

Hanover, July 6, 1701

I return to my meditations and the long-interrupted duty of my correspondence, and I beg your forgiveness for not having answered your last letter sooner. It is usually the case that I postpone longer than I ought the things with which I wish to take the most pains. I only wish that I could satisfy you the better for having delayed so long. But I turn to your letter.

You say a substance is that whose concept so represents a unity that nothing of the thing represented can be removed without the whole perishing. But cannot there be a substance which adds new perfections to those of others?[217] But, if I am not mistaken, each single perfection of the thing represented is matter. Thus the Democriteans think of space as a substance and of body as a more perfect substance which adds resistance to extension. (As you well observe, these examples do not need to be true; they are given merely to clarify.) Some of the moderns think that a new perfection can be added to certain bodies, namely, that of thought, and the School has long held that, besides the simple animated body, there is a more perfect body which senses and a most perfect one of all which is rational. I say this to point out that your concept of substance does not seem to agree with those commonly so called but only with that of the most simple substance. This is also true when you say that substance is that which is conceived in itself, an opinion to which I have opposed the proposition that an effect cannot be conceived better than through its cause, but that all substances except the first have a cause. You reply that we need a cause to conceive the existence of a substance but not to conceive its essence. But to this I answer that the concept of a possible cause is needed for conceiving its essence, but to conceive its existence the concept of an actual cause is needed. I can already foresee the elegant rejoinder which you will make to this, based on an example in geometry. The essence of an ellipse, for instance, does not depend on a cause, since the same ellipse can be produced by different causes—the section of a cone, a cylindrical section, the motion of a string. But the existence of an ellipse cannot be thought of without assuming some determinate cause. My reply to this, however, is twofold. First, though it is not necessary to conceive a determinate mode of generation to think of the essence of an ellipse, this essence, whether of an ellipse or anything else, cannot be conceived perfectly unless its possibility can be demonstrated a priori through some formal cause which exists in every individual method of generation. And to do this we must necessarily add some simpler lines. In the second place, I have already established the fact that incomplete things such as lines or figures can be similar to each other even if they are produced by different causes, as an ellipse made by a conic section may be similar to an ellipse made by motion in a plane. But in completely determined things this cannot happen, and so one substance is not perfectly similar to another, nor can the same substance be generated in many different ways.[218] On this ground (as well as on other considerations) I once also concluded that there are no atoms, that space is not a substance, and that primary matter itself, or matter separate from all activity, cannot be included among substances.

I come now to the modes, which I agree with you in distinguishing from other predicates, that is, from attributes and properties. Yet if we define them merely in terms of their needing another concept, properties will also be modes. It is common to both properties and modes to be in something. But this same definition will also fit things which are not contained in something, such as effects which need causes to be understood, as I have already said. On this basis all effects would be modifications of their causes, and the same thing could be the mode of many things at the same time, since the same thing can be the effect of many concurrent causes. Who will deny, too, that one substance is modified by the intervention of another, as when a body is repelled by some obstacle in its path? In order to conceive the rebound of one of these bodies, therefore, the concept of both of them will be necessary, yet the rebound can be the modification of only one, since the other may continue in its path without rebound. Something more is needed in the definition of a modification, therefore, than the necessity of another concept, and to be contained in (a quality which is common to both properties and modes) is more than to need something else. In my opinion there is nothin in the whole created universe which does not need, for its perfect concept, the concept of everything else in the universality of things, since everything flows into[219] every other thing in such a way that, if anything is removed or changed, everything in the world will be different from what it now is.

For the rest, if *A* and *B* are two substances in the sense in which you define them, that is, most simple, I admit that they cannot have a common predicate; yet it does not necessarily follow from this that there cannot be some third thing C which needs both of them for its concept. For just as relations result from a plurality of absolute terms, so qualities and actions also result from a plurality of substances. And just as a relation is not compounded from as many relations as there are terms to be related, so neither are the other modes which depend upon many things resolvable into many modes.[220] It does not follow, then, that a mode which requires many things is not a unity but a composite of many modes. Besides, it is not clear how any modes could possibly arise, according to your notion of them. For a substance such as you define, which has only a simple representation or one attribute, will have only one mode, and it does not appear how any diversity can arise, since only one can come from one. Hence its mode will be invariant, contrary to your hypothesis. But, even more, there will not even be any mode, since it does not appear how there can come to be a mode different from an attribute. So if we say, as is usually done, that a body contains nothing but extension, and then conceive extension as a kind of simple and primitive attribute, we can in no way explain how any variation can arise in bodies or how a plurality of bodies can exist. I have in fact demonstrated elsewhere, in my reply to Sturm which was published in the Leipzig Acts, that, if matter were not heterogeneous (which it becomes through the entelechies), there could arise no variety of phenomena, and as a result equivalents would always replace each other.[221] For the rest, I make no distinction here between the general concept of substance and the concept of a determinate substance, for all substance is determinate, though different substances are determined in different ways. As for my own notion of substance, I should prefer to have it arise from our mutual discussion rather than to produce it myself and intrude it, so to speak; certainly we seem to me to have made a good beginning.

In turning back to the earlier of your two letters, I noticed some matters which still need comment in order to form a better idea of the whole problem. It will be difficult to give examples of a concept from which no representative mark can be removed. Primitive concepts lie concealed in derivative ones but are hard to distinguish in them. I doubt that a body can be conceived apart from motion; I admit that motion cannot be conceived apart from body. But in the concept of motion there are included not only body and change but a reason and a determinant of change as well, which cannot be found in a body if its nature is considered to be purely passive, that is, to consist in extension alone or even in extension and impenetrability. In extension I think of many things together—on the one hand, continuity, which it has in common with time and motion, and, on the other, coexistence. So it is not necessary to think of extension either as a whole or as nothing at all. To make extension possible, moreover, there must clearly be something which is repeated continuously, or a plurality of things which coexist continuously. You ask, Sir, what it is that we can think of in a thing to which we ascribe extension, aside from this extension itself. I reply that action and passion must be added to extension in the thing itself. Then, you reply, extension will be a mode of the extended. I answer that extension, in my sense of the term, will not be a mode of the substances from which it results, because it is itself invariable and designates a numerical determination of these things which remains the same in any change whatever. And you will surely agree with me that modes must be variable. Meanwhile I admit that not only extension but also action and passion cannot be thought of by themselves and that it is neither necessary nor easy to arrive at concepts of ultimate simplicity, as I have already remarked. So if we insist on such a concept alone as the concept of substance, I fear that we shall have to set aside all created substances—and this would be to cut the knot, not to untie it. . . .

V

[Further efforts by the two correspondents to refine their respective notions of substance, and of the relation of continuity, coexistence, and plurality in extension, led at length to the following clear statement by Leibniz.]

[G., II, 239-41]

Hanover, April, 1702

. . . I do not believe that in the general concept of substance only one unique perfection is to be considered. You seem indeed not to accept any substance save with one attribute, and this is consistent with your concept of substance. For assuming that there is a substance with attributes *A* and *B*, then since there can, for you, be another substance with attribute *A*, it is evident that substance *AB* cannot be conceived through itself but only through substance *A*. Hence you will not consider it a substance. Nor can there be any reason, if one absolute, simple attribute can constitute a substance by itself, why another could not do so as well. But, once you have assumed that every substance has one simple attribute, you cannot in the nature of things understand the origin of modifications and changes, for whence can these come but from substances? I, in contrast, hold that there is no substance which does not involve a relation to all the perfections of any other substances whatsoever. Hence no substance with but one attribute can be conceived, nor can we, so far as I know, conceive of an attribute or simple and absolute predicate by itself. I know that the Cartesians have felt otherwise about the former point, and Spinoza about the latter, but I know also that this resulted from a lack of adequate analysis, the touchstone of which is a demonstration of predicates from the subject. For every demonstrable proposition whose demonstration we do not have must contain an insufficiently analyzed term.

When I say that every substance is simple, I understand by this that it lacks parts. Indeed, if all things which have a necessary connection with each other constituted one substance, it would follow, assuming that we exclude a vacuum, that all parts of matter would compose one substance, since they have a necessary connection. But this same reasoning would confuse substance with an aggregate of substances, whereas you point out quite correctly that we are here seeking the notion of substance, not that of an aggregate of substances.

I do in fact accept the proposition against which, I believe, you argue that I ought not to accept it, namely, "that if the extended were conceived by itself alone, it would not be extended," for such an extended being would imply a contradiction. I also think it certain that what can be conceived by itself alone cannot be located in space. To be in a place is not a bare extrinsic denomination; indeed, there is no denomination so extrinsic that it does not have an intrinsic denomination as its basis. This is itself one of my important doctrines.[222]

. . . If I am not mistaken, you said that if two predicates which belong together to the concept of a subject C are separable, that is, as I interpret it, if they can be found without each other in other subjects, then the concept C is not a unitary one. I offered the example of a square, whose predicates are those of being rectangular and equilateral, two predicates which do not occur together elsewhere. This separation, moreover, is certainly not merely one made in the mind; it exists in nature, since a quadrilateral may be rectangular but not equilateral, and a triangle may be equilateral and not rectangular. I cannot make a satisfactory application of your answer in your last letter. I admit that at least some proportion between its sides is inseparable from the concept of a rectangle, but such proportionality is one predicate, the proportion of equality is another, and the two differ as genus and species. It makes no difference whether the square has a "prerogative of simplicity" over other rectangles if, indeed, it does have it. Moreover, these two predicates also generally require different causes. Let *AB* be moved along *CD* [perpendicular to it]; then the cause which makes *A* or *C* a right angle is one thing and that which makes *AB* equal to *CD* is another. It is easy to see, therefore, that this motion produces different effects. Yet the concept of the square is nonetheless one.

Any two things *A* and *B* not only have in common that they are things or substances; they also have some kind of "sympathy," as I remember saying in earlier letters to which you did not seem to object.

The Cartesians think that some substance can be constituted by extension alone because they conceive of extension as something primitive. But if they undertook to analyze the concept, they would see that extension alone cannot suffice for an extended being, any more than number suffices for the things that are enumerated. I agree with you that just as the concept of the number 3 is not adequate to understand three particular things, so the concept of diffusion is inadequate to understand the nature of what is diffused. This is itself the very nature into which I think we ought to inquire. And I leave it to your judgment whether this can be anything but a force [τὸ δυναμικόν] from which activity and passivity follow.

Finally, granted that the a priori demonstration such as you desire for everything cannot be given, will this make my hypothesis accord any less with the facts? If you allow that it can be proved a posteriori, it will also be more valid than a hypothesis. And is any reason that can be adduced more valid against your concept of substance than the one which you yourself now acknowledge—that on the basis of it no modifications and changes can arise? Granted therefore that its impossibility is not to be demonstrated, it would suffice to build our concepts so that they agree with experience and practice, and to resolve our difficulties so that the road to higher reasons is opened. If any doubts are raised against my remarks, therefore, I shall try to reply freely and candidly, just as I have done until now. And perhaps you will look in vain for even this in other hypotheses.

VI

[On August 19, 1702, Leibniz sent De Volder a copy of his response to Bayle's second criticism (No. 60). In his next letter De Volder demanded that, if mass and entelechy be combined in the same substance, a necessary connection should be demonstrated between them. Leibniz replied, in one of the most important letters in the series, with a comprehensive exposition of his notion of individual substance.]

[G., II, 248-53]

Hanover, June 20, 1703[223]

I am replying to both of your deeply thoughtful letters in one and the same writing. I hope that my reply to Bayle has made my opinion about most matters clearer to you as well; if I am not mistaken, your letter shows that it has. Mr. Bayle himself writes that he now has a deeper insight into my hypothesis; his only remaining difficulty seems to concern the possibility of a spontaneous progression of thoughts in the soul. But there is no difficulty here for me, either from the side of experience—for since we often perceive such progression why cannot we believe it possible otherwise as well—or on a priori grounds, since I conclude that it is necessary from the very nature of all substance, which must act or have a tendency. Add to this also the fact that the present is everywhere pregnant with the future (in completely determined things, that is), so that all future states are pre-established in the present state.

Your own objections arise from other sources. I turn back first to your earlier letter, in which you ask for a necessary connection between matter (or resistance) and active force, so that they need not be joined superficially only. But the cause of this connection is the fact that every substance is active and every finite substance is passive as well, and connected with this passivity is resistance.

Such a conjunction is therefore demanded by the nature of things, which cannot be so impoverished as to lack a principle of action, and does not permit a vacuum of forms any more than of matter—not to mention the fact that the sources of action and of unity are the same.

I do not at all approve of the doctrine of attributes which people are formulating today; as if one simple absolute predicate, which they call an attribute, constituted a substance. Nor do I find any entirely absolute predicates in concepts, that is, any which do not involve connections with other predicates. Certainly thought and extension, which are commonly proposed as examples, are far from being such attributes, as I have often shown. And, unless the predicate is taken concretely [in concreto], it is not the same as the subject; so the mind coincides with the thinker indeed (though not formally) but not with the thinking. For it is a property of the subject to involve future and past thoughts in addition to present ones.[224]

Those who find the distinction between bodies to lie solely in what they think of as modes of extension (as almost everybody does today, you say) claim that, in excluding a vacuum, they do not reject the view that bodies differ from each other only modally.[225] But two individual substances must be distinguished more than modally. Besides, as the matter is commonly understood, they will not even be found to be distinguished modally. For if you assume two bodies A and B to be equal and with the same figure and motion, it will follow from such a concept of body, that is, a concept drawn solely from the putative modes of extension, that these bodies will have no intrinsic marks at all by which to be distinguished. Does this mean that A and B are not diverse individuals? Or is it possible for two things to be diverse which can in no way be distinguished? This and countless other considerations of the same kind show conclusively that this new philosophy which forms substances out of material or passive entities alone completely upsets the true conceptions of things. Things which are different must differ in something or must have within themselves some diversity that can be noted. It is strange that men have not applied this most obvious axiom, along with so many others. But people are generally content to satisfy their imaginations and do not worry about reasons; hence so many monstrosities introduced to the injury of the true philosophy. Thus they commonly use only incomplete and abstract concepts, which thought supports but which nature does not know in their bare form; such notions as that of time, also of space or of what is extended only mathematically, of merely passive mass, of motion considered mathematically, etc. Such concepts men can easily imagine to be diverse without diversity—for example, two equal parts of a straight line, since the straight line is something incomplete and abstract, which needs to be considered only in theory. But in nature every straight line is distinguishable by its contents from every other. Hence it cannot happen in nature that two bodies are at once perfectly similar and equal. Also, things which differ in position must express their position, that is, their surroundings, and are hence not to be distinguished merely by their location or by a solely extrinsic denomination, as such things are commonly understood. Hence there can be no bodies in nature as they are commonly conceived, like the atoms of the Democriteans and the perfect globules of the Cartesians, and these are nothing but the incomplete cogitations of philosophers who have not thoroughly investigated the natures of things.[226] In my last reply to Sturm I used another unassailable argument besides to demonstrate that, given a plenum, it is impossible for matter as it is commonly thought of as formed solely out of the modifications of extension, or, if you prefer, out of passive mass, to suffice for filling the universe, but that it is obviously necessary to assume something else in matter from which we may get a principle of change and one by which to distinguish among phenomena; and hence we need some alteration, and therefore some heterogeneity, in matter in addition to increase, diminution, and motion. But I do not admit any generation or corruption in substance itself.

I turn now to your other letter. When I say that, even if it is corporeal, a substance contains an infinity of machines, I think it must be added at the same time that it forms one machine composed of these machines and that it is actuated, besides, by one entelechy, without which it would contain no principle of true unity. I think that what has been said shows the evident necessity which forces us to admit entelechies. Also, if we are to have real beings and substances, I do not see how we can avoid true unities. Of course the arbitrary unities used in mathematics do not belong here, for they can be applied just as well to apparent entities such as all beings by aggregation—a herd, an army—whose unity comes from thought. This is the same in every aggregate; you will find no true unity if you take away the entelechy.

Properly and exactly speaking, perhaps we should not say that the primitive entelechy impels the mass of its own body but that it is merely combined with a passive primitive power which it completes, or with which it constitutes a monad. Nor can it influence [influo in] the other entelechies or substances which exist in the same mass. But in phenomena, or in the resulting aggregate, everything is explained mechanically, and so masses are understood to impel each other. In these phenomena it is necessary to consider only derivative forces, once it is established whence these forces arise, namely, the phenomena of aggregates from the reality of the monads.

In my opinion there never arises a natural organic mechanism that is new, because it always possesses infinite organs, so that it may express the whole universe in its way; indeed, it always involves all past and present time. This is the most certain nature of every substance. And we know that what is expressed in the soul is also expressed in the body; hence the soul as well as the machine animated by it, and the animal itself, are as indestructible as the very universe. It is for this reason that such a machine cannot be put together, any more than it can be destroyed, by any mechanical process. Nor can any primitive entelechy ever come into being or be extinguished naturally or ever lack an organic body. So far as my study of things carries me, at least, this cannot be otherwise, and my opinions on this score are not derived from our ignorance about the formation of the fetus but from higher principles.

I regard substance itself, being endowed with primary active and passive power, as an indivisible or perfect monad—like the ego, or something similar to it—but I do not so regard the derivative forces, which are found to be changing continuously. But if there were no true one, then every true being would be eliminated. The forces which arise from mass and velocity are derivative and belong to aggregates or phenomena. When I speak of a primitive force as enduring, I do not mean the conservation of the total motive power, which we discussed together earlier, but an entelechy which always expresses this total force as well as other things. Derivative forces are in fact nothing but the modifications and echoes of primitive forces.

So you see, esteemed Sir, that corporeal substances cannot be constituted solely out of derivative forces combined with their resistance, that is, out of vanishing modifications. Every modification presupposes something permanent. Therefore when you say, "Let us assume that there is nothing in bodies but derivative forces," I reply that such a hypothesis is impossible and that it again gives rise to the error of taking incomplete notions for the completely determined concepts of things.

I do not admit any action of substances upon each other in the proper sense, since no reason can be found for one monad influencing another. But in appearances composed of aggregates, which are certainly nothing but phenomena (though well founded and regulated), no one will deny collision and impact. Meanwhile I discover that it is further true in phenomena and derivative forces that masses do not so much give new force to other masses as they give determinate direction to the force already existing in them, so that one body is repelled away from another by its own force rather than being propelled by the other.

Entelechies must necessarily differ or not be completely similar to each other; in fact, they are principles of diversity, for they each express the universe from their own point of view. This is their office, that they should be so many living mirrors or so many concentrated worlds. Yet we rightly say that the souls of like-named animals, such as human souls, belong to the same species not in the mathematical but in the physical sense in which father and son are agreed to be of the same species.

If you think of mass as an aggregate containing many substances, you can still conceive of a single pre-eminent substance or primary entelechy in it. For the rest, I arrange in the monad or the simple substance, complete with an entelechy, only one primitive passive force which is related to the whole mass of the organic body. The other subordinate monads placed in the organs do not make up a part of it, though they are immediately required by it, and they combine with the primary monad to make the organic corporeal substance, or the animal or plant. I therefore distinguish: (1) the primitive entelechy or soul; (2) primary matter or primitive passive power; (3) the complete monad formed by these two; (4) mass or secondary matter, or the organic machine in which innumerable subordinate monads concur; and (5) the animal or corporeal substance which the dominating monad makes into one machine.

You doubt whether a single simple thing is subject to changes. But since only simple things are true things, and the rest are beings by aggregation and therefore phenomena, existing, as Democritus put it, by convention but not by nature [νόμῳ not φύσει], it is obvious that, unless there is change in the simple things, there will be no change in things at all. Nor must every change be from without; on the contrary, an internal tendency to change is essential to finite substance, and no change can arise naturally in the monads in any other way. But in phenomena or aggregates every new change arises from a impact according to laws prescribed partly by metaphysics, partly by geometry; for abstractions are necessary for the scientific explanation of things. Hence we regard the individual parts within a mass as incomplete, and each as contributing its part, but completed only by the combination of all. So any body whatever, taken by itself, is understood to strive in the direction of a tangent, though its continuous motion in a curve may follow from the impressions of other bodies. But in a proper substance which is complete in itself and involves everything together, the construction of this curved line is itself contained and expressed, because everything future is predetermined in the present state of the substance. For there is as great a difference between substance and mass as there is between complete things as they are in themselves and incomplete things as we accept them through abstraction. It is by means of this abstraction that we can define in phenomena the role to be ascribed to each part of mass and can distinguish and explain the whole phenomenon rationally—a thing which necessarily requires abstractions.

You seem to have rightly grasped my doctrine of how every body whatever expresses all other things, and how every soul or entelechy whatever expresses its own body and through it all other things. But when you have uncovered the full force of this doctrine, you will find that I have said nothing else which does not follow from it.

I had said that extension is the order of possible coexistents and that time is the order of possible inconsistents. If this is so, you say you wonder how time enters into all things, spiritual as well as corporeal, while extension enters only into corporeal things. I reply that the relations are the same in the one case as in the other, for every change, spiritual as well as material, has its own place [sedes], so to speak, in the order of time, as well as its own location in the order of coexistents, or in space. For, although monads are not extended, they nevertheless have a certain kind of situation [situs] in extension, that is, they have a certain ordered relation of coexistence with others, namely, through the machine which they control. I do not think that any finite substances exist apart from a body and that they therefore lack a position or an order in relation to the other things coexisting in the universe. 227

Extended things involve a plurality of things endowed with position, but things which are simple, though they do not have extension, must yet have a position in extension, though it is impossible to designate these positions precisely as in the case of incomplete phenomena.

VII

[The letters which follow are largely repetitive of the points already made, but the sections here translated excel in the clarity and sharpness of Leibniz's statements.]

[G., II, 257-59]

Hanover, November 10, 1703

. . . You seem to desire a cause from me where you yourself do not yet admit the effect. So we must first agree upon the "that" [τὸ ὅτι], that is, upon the question of fact, whether every substance, at least every one known to us, can be considered as active. And this is a question which can be answered from phenomena.

You are of the opinion that the resistance in a substance can accomplish nothing more than that the substance opposes its own active power. But this should not seem strange to you, since it happens even in quasi-substances or bodies that their mass limits the velocity which another body strives to impress upon them. But in things that are limited we need a principle of limitation, just as we need a principle of action in acting things.

The intrinsic difference between bodies you attribute not so much to the things themselves as to my hypothesis. But I had added a demonstration taken from phenomena—to the effect that, if this difference did not exist, one state of matter in a plenum could not be distinguished from another, for equivalents could always be substituted for each other. This applies chiefly to the Cartesians, who do not recognize qualities or forces in matter but only translation, as if God placed a body first in one position and then in another and then gave the mind arbitrary sensations which do not correspond to the properties of the body. It also applies especially to Malebranche, Sturm, and other occasionalists, who ascribe all force or active power to God alone, so that there is no principle of distinction in corporeal things themselves. You therefore disagree with both of these positions and agree with me in accepting derivative forces, hoping that in this way the diversities in phenomena can be explained. But then you should do justice to my other argument—that derivative or accidental forces are mere modifications and that an active thing cannot be the modification of something passive, since a modification is merely a varying limitation, and modes merely limit things but do not increase them and hence cannot contain any absolute perfection which is not in the thing itself which they modify. Otherwise, in fact, these accidents must be thought of in the manner of substances, namely, as something which stands per se. So you either must accept my opinion or take refuge in the misnomer [ἀλλόγλωσσον] which you suggest in the view that perhaps the whole universe is merely one substance. To use the word "substance" in this sense is to twist it out of the sense others give it. And I do not see any argument by which such a paradox could be made probable; those offered by Benedict de Spinoza for such a view do not seem, if I am any judge, to contain even the shadow of a proof. Besides, even setting aside this discussion of the word "substance," it is enough that you admit different subjects or things which contain modes; with this admission the argument which I have given, that a mode merely limits and does not augment its subject, is still valid. This makes it clear that motion is inadequate without forces, and derivative forces are inadequate without primary entelechies.

In order to refute what I said about an internal tendency to change being essential to finite substance, you say, "Whatever follows from the nature of a thing is in that thing in an invariant mode, at least as long as the same nature persists in the thing, nor can it be taken away from it, since there is a necessary connection between it and the nature of the thing." But from this it would follow that nothing is active by nature, for action is always a change in the acting creature. I reply that we must distinguish between properties which are perpetual and modifications which are transitory. Whatever follows from the nature of a thing can either follow from it permanently or temporarily, and, if temporarily, either at once and immediately, that is, in the present, or by the mediation of some prior modification, so that it is future. There is an image of this in quasi-substances or bodies which have force or are placed in motion. It follows from the nature of a body moving in a straight line at a given velocity, if no extraneous force be assumed, that after a given time has elapsed it will arrive at a given point on the straight line. Does this mean, therefore, that it arrives at this point permanently? Grant me therefore in the primitive tendencies what it is necessary to recognize in the derivative. The case is like that of mathematical laws of series, or the nature of curves, where the entire progression is sufficiently contained in the beginning. Nature as a whole must be like this; otherwise it would be absurd and unworthy of wisdom. Nor do I see even the appearance of a reason for doubting it, except that we are frightened by the unusual. . . .

VIII

[G., II, 262-65]

Brunswick, January 21, 1704

. . . You speak as if you do not understand what I intend when I say that derivative forces are mere modifications and that the active cannot be a modification of the passive. Don't you understand, then, what is meant by modification, by active and passive? Meanwhile, reading I know not what obscurities into the argument, you have nibbled so cursorily at what I have written that you even ascribe to me what I did not say or, rather, the very opposite of what I did say. For you interpret me as denying that derivative forces are active, since you say, "Therefore, I do not see why these (derivative) forces are not active." But so far am I from denying that they are active that I infer, from the very fact that they are active and yet modifications, that there is something primary and active of which they are modifications.

You assert that motion, or the product of mass and velocity, constitutes the derivative forces. I, however, do not consider motion to be a derivative force but think rather that motion, being change, follows from such force. Derivative force is itself the present state when it tends toward or preinvolves a following state, as every present is great with the future. But that which persists, insofar as it involves all cases, contains primitive force, so that primitive force is the law of the series, as it were, while derivative force is the determinate value which distinguishes some term in the series.

I do not recall who preceded Spinoza in saying that there is one substance in the whole universe, so you will pardon my calling him to mind, especially since I used him merely as an illustration.

If bodies are not substances insofar as they are this or that particular body, they are not individual substances. This would be like saying that Peter is a substance only insofar as he is a man or that species are substances but that individuals are not. Besides, the totality of bodies will also not be an individual substance in this sense, for what is this but the aggregate of all individual substances, unless you call in something else which is to persist—as the thinker of whom I spoke is compelled to do. And this enduring something will be a substance only because it is also a monad. In fact, he could have found an analogy of what he ascribed to the universe as a whole, in each of its parts. Substances are not mere wholes which contain parts formally but total things which contain their partials eminently. 228

If nothing is active by its own nature, there will be nothing active at all, for what reason for activity can there be if not in the nature of a thing? Yet you add the restriction that "a thing can be active by its own nature, if its action always maintains itself in the same mode." But, since every action contains change, we must have in it precisely what you would seem to deny it, namely, a tendency toward internal change and a temporal succession following from the nature of the thing.

You of course deny that "from the nature of a thing there follows that which belongs to it merely temporarily." You prove this by the nature of a triangle, but you do not distinguish between universal and particular natures. From universal natures there follow eternal consequences; from particular natures also temporal ones, unless you think that temporal things have no cause.

"I do not see," you say, "how any succession can follow from the nature of a thing, viewed in itself." This is indeed impossible if we assume that this nature is not individual. "Unless," you add, "the thing itself is a succession." But all individual things are successions or are subject to succession, and so your view coincides with my own. For me nothing is permanent in things except the law itself which involves a continuous succession and which corresponds, in individual things, to that law which determines the whole world.

Besides, you yourself recognize that in the case of quasi-substances, as I call them, it follows from the nature of a moving body that, if nothing prevents it, it will arrive at a given point in a given time. You admit therefore that temporal things follow from the nature of particular things. What your objection is, I do not see.

You say that in a series, such as one of numbers, nothing is thought of as successive. What of it? I do not say that every series is a temporal succession but only that a temporal succession is a series, which has in common with other series the property that the law of the series shows where it must arrive in continuing its progress or, in other words, the order in which its terms will proceed when its beginning and the law of its progression are given, whether that order is a priority of essences only or also one of time.

I do not agree with your statement that "all of the terms in a series are contained in it in a single invariant way." This takes place in a certain way only in a uniform series, but there are series which contain maxima, minima, bend points, etc.

When you say that "God bestowed upon matter at the beginning of the world only derivative forces," you are already tacitly assuming primitive forces in matter, because we cannot understand what matter would be except through monads, since it would always be an aggregate or, rather, the result of a plurality of phenomena, until we arrived at these simple beings.

"Nothing," you say, "prevents substances of the same nature from acting upon each other." But you know that philosophers have rather denied any action between similar beings. And what is there that prevents substances which differ in nature from acting upon each other? When you have explained this, you will see that your explanation prevents all finite substances from influencing each other—not to mention the fact that all substances are different in nature, and there are no two things in nature which differ in number alone. When such a thing is conceived, it is by a fiction of the mind which is ignorant of the difference or is concealing it, or abstracting from it. There is only one case of one substance acting immediately upon another, the action, namely, of infinite substance upon finite substances—an action which consists in continuously producing or constituting them. For there must necessarily be a cause why these finite substances exist and correspond with each other, and this must necessarily arise from the infinite substance which is necessary per se. But if it is claimed that substances do not remain the same but that different substances which follow upon prior ones are always produced by God, this would be to quarrel about a word, for there is no further principle in things by which such a controversy can be decided. The succeeding substance will be considered the same as the preceding as long as the same law of the series or of simple continuous transition persists, which makes us believe in the same subject of change, or the monad. The fact that a certain law persists which involves all of the future states of that which we conceive to be the same—this is the very fact, I say, which constitutes the enduring substance.

And if anyone concedes to me that there is an infinity of percipients, in each of whom there is a fixed law of the progression of phenomena, that the phenomena of these different percipients correspond with each other, and that there is a common reason for both their existence and their correspondence in the thing which we call God, this is all that I claim in the matter, and all that I think can be claimed. All other positions and issues, I believe, arise only from poorly analyzed notions, and I shall be surprised if anyone shows that anything more can be added to these. If we had always kept this in mind in our dispute, we should have avoided much wrangling.

You say, "Experience teaches us that changes take place, but our question was not what experience teaches but what follows from the nature of things." But do you think that I either could or should wish to prove anything in nature if change were not presupposed? But you say, "No experience teaches us that changes arise from within [ab intrinseco]." Nor have I urged this on the basis of experience.

"The modes of action in the mind," you say, "are too obscure." I thought they were most clear; indeed, that they alone are clear and distinct. I thought you agreed that at least something in the mind comes from within, or not from any other finite substance, and hence I perhaps inferred that my opinion would be intelligible to you. But you take this to mean that I have assumed as axiomatic that everything in the mind is of such a nature. I admit that this is the view which I hold, but I do not postulate it. . . .

IX

[G., II, 268-71]

Hanover, June 30, 1704

. . . You continue by saying, "Nevertheless (your argument) does not convince me that a mathematical body has no reality, unless perhaps there is some ambiguity in the word 'reality.' For I conceive of the innumerable properties of such a body with the greatest evidence." To this I reply in two ways. First, it is a necessary inference from my principles that a mathematical body is not real and, second, that the arguments you urge, for saying that you conceive a body most clearly (as real), do not establish its reality.

As for the first point, it follows from the very fact that a mathematical body cannot be analyzed into primary constituents that it is also not real but something mental and designates nothing but the possibility of parts, not something actual. A mathematical line, namely, is in this respect like arithmetical unity; in both cases the parts are only possible and completely indefinite. A line is no more the aggregate of the lines into which it can be cut than unity is the aggregate of the fractions into which it can be split up. And, as in counting, the number is not a substance without the things counted, so neither is a mathematical body or extension without active and passive entities or motion. But in real things, that is, bodies, the parts are not indefinite—as they are in space, which is a mental thing—but actually specified in a fixed way according to the divisions and subdivisions which nature actually introduces through the varieties of motion. And granted that these divisions proceed to infinity, they are nonetheless all the results of fixed primary constituents or real unities, though infinite in number. Accurately speaking, however, matter is not composed of these constitutive unities but results from them, since matter or extended mass is nothing but a phenomenon grounded in things, like the rainbow or the mock-sun, and all reality belongs only to unities.

Phenomena can therefore always be divided into lesser phenomena which could be observed by other, more subtle, animals, and we can never arrive at smallest phenomena.[229] Substantial unities are not parts but foundations of phenomena.

I come now to the ground of your objection, esteemed Sir. "I conceive with greatest evidence," you say, "the innumerable properties of a mathematical body." I grant this, in the same sense, that is, in which the properties of number and time are conceived, concepts which are also only orders or relations pertaining to possibility and to the eternal truths of the world, and are then further applicable to actual events. But you add, "I conceive of a mathematical body as existing and inhering in nothing else." This I do not admit, unless we also conceive of time as existing or inhering in nothing. If you regard this mathematical body as space, it must be correlated with time; if as extension, it must be correlated with duration. For space is nothing but the order of existence of things possible at the same time, while time is the order of existence of things possible successively. As a physical body is to space, so the status or series of things is to time. The body and the series of things add to space and time, motion or action and passion, and the principle of motion.[230] For as I have repeatedly reminded you—though you seem to have neglected my reminders—extension is an abstraction from the extended and can no more be considered substance than can number or a multitude, for it expresses nothing but a certain nonsuccessive (i. e., unlike duration) but simultaneous diffusion or repetition of some particular nature, or, what amounts to the same thing, a multitude of things of this same nature which exist together with some order between them; and it is this nature, I say, which is said to be extended or diffused. The notion of extension is thus relative, or extension is the extension of something, just as we say that a multitude or a duration is a multitude, or a duration, of something. But this nature which is said to be diffused, repeated, and continued is that which constitutes a physical body, and it can be found in no other principle but that of acting and enduring, since no other principle is suggested to us by the phenomena. But of what kind this action and passion are, I shall say later. So you see that, once we begin an analysis of concepts, we always arrive at last at the view which I am urging. It is really not surprising that the Cartesians have failed to understand the nature of corporeal substance and to arrive at true principles, since they consider extension as something absolute, irresolvable, ineffable, or primitive. For trusting their sense perceptions, and perhaps also seeking the applause of men, they were content to stop where their sense perception stopped, even though they also boasted, elsewhere, that they had distinguished sharply between the sensible and the intelligible realms.

"By forces," you say, "I have always meant something nonsubstantial but inhering in substance." And rightly so, if you mean mutable forces. But when force is taken to be the principle of action and passion, which is thus modified by derivative forces or by what is momentary in action, you can understand enough from what I have said that this is involved in the concept of extension itself, which is relative per se, and that, by your own analysis of corporeal substance, we must come to this conclusion. This is even more clear, as was shown above, when we consider the analysis of aggregates and of the phenomena in unities and reality.

You add, "I have always considered forces, viewed apart from the foundations from which they spring, as being in the nature of an external denomination." I should prefer to consider derivative forces in relation to their foundations, as a figure in relation to extension, that is, as a modification. And you know from my calculus, in which I have demonstrated the true measure of derivative forces a priori, that force multiplied by the time through which it acts equals action and that force is therefore the momentaneous factor in action but with a relation to the following state. I have often said—and do not remember ever to have deviated from this position—that, unless there were some primary active principle in us, there could be no derivative forces and actions in us, since everything accidental or changeable must be a modification of something essential or perpetual and can contain nothing more positive than that which it modifies, since every modification is only a limitation—a figure of that which is varied and a derivative force of that which varies.

You continue, "This foundation which was to be in the thing may perhaps be the same as what you call primitive forces, from which the derivative forces flow." I believe that this is most true, and so it appears that we are agreed on this point.

You add, "But I perceive nothing of these—so feeble is the force of my understanding—except that you assert that all the remaining mutations flow from them." But you do yourself an injury through your excessive modesty, for you understand the matter as far as its nature allows. Would you seek to sense things which can only be understood, to see sounds, to hear colors? You do not in fact disagree with what I have asserted—that mutations flow from them; do you regard it as nothing to know this?

It is important, however, also to consider that this principle of action is most intelligible, because there is something in it analogous to what is in us, namely, perception and appetite. For the nature of things is uniform, and our nature cannot differ infinitely from the other simple substances of which the whole universe consists. Indeed, considering the matter carefully, it may be said that there is nothing in the world except simple substances and, in them, perception and appetite. Matter and motion, however, are not so much substances or things as they are the phenomena of percipient beings, whose reality is located in the harmony of the percipient with himself (at different times) and with other percipient beings.

When Descartes and others say that "there is one substance for all corporeal beings," they mean one similar nature, and do not, I think, intend that all bodies together make one substance.

Surely the fact itself shows the world to be an aggregate, like a herd or a machine.

I had said that temporal events follow from particular things. You say that you do not object to this but that it remains to be explained how particulars differ from universals and why temporal events follow from the former and not from the latter. But, if I am not mistaken, an essential order of particulars corresponds to the definite parts of time and space, and universals are abstracted from these particulars by the mind.

Last of all, you add, "Particulars act upon each other and are thus subject to change with respect to actions. How this can be explained by substances which do not act upon each other is obscure to me." This seems to be aimed at my opinion about the pre-established harmony between simple substances, which cannot act upon each other. Yet they do produce a change in themselves, and it is necessary for this to happen from your own point of view as well. For you acknowledged above that there is an internal basis for forces or actions, and so we must recognize an internal principle of change. And, unless we do, there will be no natural principle of change at all and therefore no natural change. For if the principle of change were external to all and internal to none, there would be none at all, and we should have to turn back with the occasionalists to God as the only agent. It is therefore truly internal to all simple substances, since there is no reason why it should be in one rather than in another, and it consists in the progress of the perceptions of each monad, the entire nature of things containing nothing besides. You see how simple the matter becomes when we have arrived at principles which are manifestly necessary and sufficient, so that it seems not only superfluous but inconsistent and without explanation to add anything further. To go beyond these principles and ask why there is perception and appetite in simple substances is to inquire about something ultramundane, so to speak, and to demand reasons of God why he has willed things to be such as we conceive them to be.

I have been compelled to be more verbose in my answers in order to begin the reasoning by which I establish each point with a repetition of your own words. For I have noted that earlier, when we wrote more freely, we almost forgot what had gone before in the progression of the argument and sometimes turned in circles or digressed to other matters, which is sometimes an unintentional sign of impatience. For the rest, our esteemed common friend, John Bernoulli, has written that your health is not of the best; he himself has scarcely recovered from a serious illness. This is a great grief to me, who owe much to your thoughts and expect much fruitage still from them. So I think that you have need of gaiety, activity, and, in brief, a kind of diet adapted to the body; such a diet is the true medicine for chronic illnesses and irregularities, though we often neglect it when pulled away by custom and business.

X

[G., II, 281-83]

Hanover, January 19, 1706

. . . You rightly despair of obtaining from me what I can give you no hope of receiving and what I neither hope nor desire to find for myself. The Scholastics commonly sought things which were not only ultramundane but utopian. The brilliant French Jesuit, Tournemine, recently gave me an excellent example of this. He gave general approval to my pre-established harmony, which seemed to him to supply a reason for the agreement which we perceive between soul and body, but said that he still desired one thing—to know the reason for the union between the two, which he held to differ from their agreement. I replied that this metaphysical "union"—I know not what—which the School assumes in addition to their agreement is not a phenomenon and that there is no concept and therefore no knowledge of it. So neither could I think of a reason that might be given for it.[231]

I fear that the force which is thought to be in extension or mass, yet outside of the percipient beings and their perceptions, is of this nature. For there can be nothing real in nature except simple substances and the aggregates resulting from them. But in the simple substances themselves we know nothing besides perceptions or the reasons for them. Whoever assumes more must give the marks by which the additional natures are to be verified and explained. I consider it demonstrated—as I have written several times, although I cannot yet order everything in such a way as to present the demonstration conveniently to the eyes of others—that it is essential to substance that its present state involves its future states and vice versa. And there is nowhere else that force is to be found or a basis for the transition to new perceptions.

From the things I have said it is also obvious that in actual bodies there is only a discrete quantity, that is, a multitude of monads or of simple substances, though in any sensible aggregate or one corresponding to phenomena, this may be greater than any given number.[232] But a continuous quantity is something ideal which pertains to possibles and to actualities only insofar as they are possible. A continuum, that is, involves indeterminate parts, while, on the other hand, there is nothing indefinite in actual things, in which every division is made that can be made. Actual things are compounded as is a number out of unities, ideal things as is a number out of fractions; the parts are actually in the real whole but not in the ideal whole. But we confuse ideal with real substances when we seek for actual parts in the order of possibilities, and indeterminate parts in the aggregate of actual things, and so entangle ourselves in the labyrinth of the continuum and in contradictions that cannot be explained. Meanwhile the knowledge of the continuous, that is, of possibilities, contains eternal truths which are never violated by actual phenomena, since the difference is always less than any given assignable amount. And we do not have, nor ought we to hope for, any other mark of reality in phenomena than that they correspond with each other and with eternal truths as well. . . .

56

Letter to Varignon, with a Note on the "Justification of the Infinitesimal Calculus by That of Ordinary Algebra"

1702

The criticisms to which the new infinitesimal calculus was subjected during the last decade of the seventeenth century were often grounded upon nothing more than a failure to understand its value or a distrust of novelty. Thus Huygens himself, and the Abbé Gallois, an editor of the *Journal des savants*, seem not at once to have grasped the importance of the new instrument. With more veneration for Descartes than insight into mathematics, the Abbé Catelan once more rushed into print. Among the criticisms, however, was one aimed at an unclear foundation of the calculus itself, the uncertain status and nature of the infinite and the infinitesimals which were used. In 1694 and again in 1695 this issue was raised by Bernard Nieuwentijt in two criticisms of the calculus; later the criticism was developed more convincingly by Michel Rollé, an abler mathematician. Among the defenders of the new methods were the Bernoulli brothers (cf. No. 53); the Marquis de l'Hospital, whose *Analyse des infiniment petits* (1696) was the first textbook in the field (cf. n. 68); Jacob Hermann (1678-1733); and Pierre Varignon (1654-1722), who had already made contributions to statics and was later to develop polar coordinates.

Varignon was engaged at the time of this letter in replying to Rollé's criticisms and had asked Leibniz what he meant precisely by the infinitely small. The latter's reply was published in the

Journal des savants, March 20, 1702; it suggested several levels of interpretation upon which the user of the calculus might stand. The supplement (II) had been sent to Pinson and Varignon sometime earlier and appeared in the Mémoires de Trévoux, January, 1701.

* * *

I

Letter to Varignon

[GM., IV, 91-95]

Hanover, February 2, 1702

I am a little late in replying to the letter with which you honored me on November 29 of last year but which I did not receive until today. After Mr. Bernoulli sent it to me from Groningen, it did not arrive in Berlin until after I had left to return to Hanover with the Queen of Prussia, Her Majesty having been so gracious as to ask that I be in her suite. This had delayed my return.

I am greatly obliged to you, Sir, and to your learned men who have done me the honor of reflecting upon what I wrote to one of my friends in reply to the criticisms against the calculus of differences and sums which were published in the Journal de Trévoux. I do not recall exactly what expressions I may have used, but my intention was to point out that it is unnecessary to make mathematical analysis depend on metaphysical controversies or to make sure that there are lines in nature which are infinitely small in a rigorous sense in contrast to our ordinary lines, or, as a result, that there are lines infinitely greater than our ordinary ones (yet with ends; this is important inasmuch as it has seemed to me that the infinite, taken in a rigorous sense, must have its source in the unterminated; otherwise I see no way of finding an adequate ground for distinguishing it from the finite).[233] This is why I believed that, in order to avoid subtleties and to make my reasoning clear to everyone, it would suffice here to explain the infinite through the incomparable, that is, to think of quantities incomparably greater or smaller than ours. This would provide as many degrees of incomparability as we may wish, since that which is incomparably much smaller has no value whatever in relation to the calculation of values which are incomparably greater than it. It is in this sense that a bit of magnetic matter which passes through glass is not comparable to a grain of sand, or this grain of sand to the terrestrial globe, or the globe to the firmament. It was to make this point that I once submitted some lemmas on incomparables to the Leipzig Acts, which could be understood as applicable either to infinites in the rigorous sense or merely to magnitudes which do not need to be considered in relation to others.

But at the same time we must consider that these incomparable magnitudes themselves, as commonly understood, are not at all fixed or determined but can be taken to be as small as we wish in our geometrical reasoning and so have the effect of the infinitely small in the rigorous sense. If any opponent tries to contradict this proposition, it follows from our calculus that the error will be less than any possible assignable error, since it is in our power to make this incomparably small magnitude small enough for this purpose, inasmuch as we can always take a magnitude as small as we wish. Perhaps this is what you mean, Sir, when you speak of the inexhaustible, and the rigorous demonstration of the infinitesimal calculus which we use undoubtedly is to be found here.[234] It has the advantage of giving such a proof visibly and directly and in a way well fitted to reveal the source of the invention, while the ancients, like Archimedes, gave it indirectly in the form of their reductions to the absurd; but they were unable to arrive at complicated truths or solutions in default of such a calculus, though they possessed the foundation of the invention. It follows from this that, even if someone refuses to admit infinite and infinitesimal lines in a rigorous metaphysical sense and as real things, he can still use them with confidence as ideal concepts which shorten his reasoning, similar to what we call imaginary roots in the ordinary algebra, for example, $\sqrt{-2}$. Even though these are called imaginary, they continue to be useful and even necessary in expressing real magnitudes analytically. For example, it is impossible to express the analytic value of a straight line necessary to trisect a given angle without the aid of imaginaries. Just so it is impossible to establish our calculus of transcendent curves without using differences which are on the point of vanishing, and at last taking the incomparably small in place of the quantity to which we can assign smaller values to infinity. In the same way we can also conceive of dimensions beyond three, and even of powers whose exponents are not ordinary numbers—all in order to establish ideas fitting to shorten our reasoning and founded on realities.

Yet we must not imagine that this explanation debases the science of the infinite and reduces it to fictions, for there always remains a "syncategorematic" infinite, as the Scholastics say.[235] And it remains true, for example, that $2 = \frac{1}{1} + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \ldots$, which is an infinite series containing all the fractions whose numerators are 1 and whose denominators are a geometric progression of powers of 2, although only ordinary numbers are used, and no infinitely small fraction, or one whose denominator is an infinite number, ever occurs in it. Furthermore, imaginary roots likewise have a real foundation [*fundamentum in re*]. So when I told the late Mr. Huygens that $\sqrt{1+\sqrt{-3}} - \sqrt{1-\sqrt{-3}} = \sqrt{6}$, he found this so remarkable that he replied that there is something incomprehensible to us in the matter. So it can also be said that infinites and infinitesimals are grounded in such a way that everything in geometry, and even in nature, takes place as if they were perfect realities. Witness not only our geometrical analysis of transcendental curves but also my law of continuity, by virtue of which we may consider rest as infinitely small motion (that is, as equivalent to a particular instance of its own contradictory), coincidence as infinitely small distance, equality as the limit of inequalities, etc. This law I once explained and applied in Mr. Bayle's *Nouvelles de la république des lettres* and applied to the rules of motion of Descartes and Father Malebranche. I have since observed, by the second edition of the latter's rules which has since appeared, that the entire force of this principle is not yet understood.[236]

Yet one can say in general that, though continuity is something ideal and there is never anything in nature with perfectly uniform parts, the real, in turn, never ceases to be governed perfectly by the ideal and the abstract and that the rules of the finite are found to succeed in the infinite—as if there were atoms, that is, elements of an assignable size in nature, although there are none because matter is actually divisible without limit. And conversely the rules of the infinite apply to the finite, as if there were infinitely small metaphysical beings, although we have no need of them, and the division of matter never does proceed to infinitely small particles. This is because everything is governed by reason; otherwise there could be no science and no rule, and this would not at all conform with the nature of the sovereign principle.

For the rest, when my reading of the Journal de Trévoux brought me to write about the attacks made there against the differential calculus, I assert that I was not thinking of the controversy which you, or rather those who use the calculus, are having with Mr. Rollé. It is only since your last letter, too, that I learned that the Abbé Gallois, whom I always honor greatly, has taken part. Perhaps his opposition comes only from his belief that we have founded the demonstration of this calculus on metaphysical paradoxes which I myself believe we can well discard. . . . I even find that it means much in establishing sound foundations for a science that it should have such critics. It is thus that the skeptics, with as much reason, fought the principles of geometry; that Father Gottignies, a Jesuit scholar, tried to throw out the best foundations of algebra; and that Mr. Cluver and Mr. Nieuwentijt have recently attacked our infinitesimal calculus, though on different grounds. Geometry and algebra have survived, and I hope that our science of infinites will survive also. But it will always owe you a great debt for the light which you have shed upon it. I have often thought that a reply by a geometrician to the objections of Sextus Empiricus and to the things which Francis Sanchez,[237] author of the book *Quod nihil scitur*, sent to Clavius, or to similar critics, would be something more useful than we can imagine. This is why we have no reason to regret the pains which are necessary to justify our analysis for all kinds of minds capable of understanding it. . . .

II

JUSTIFICATION OF THE INFINITESIMAL CALCULUS BY THAT OF ORDINARY ALGEBRA

[GM., IV, 104-6]

Let two straight lines AX and EY meet at C, and from points E and Y drop EA and YX perpendicular to the straight line AX. Call AC, c and AE, e; AX, x and XY, y (Fig. 36). Then since triangles CAE and CXY are similar, it follows that $(x - c)/y = c/e$. Consequently, if the straight line EY more and more approaches the point A, always preserving the same angle at the variable point C, the straight lines c and e will obviously diminish steadily, yet the ratio of c to e will remain constant. Here we assume that this ratio is other than 1 and that the given angle is other than 45°.

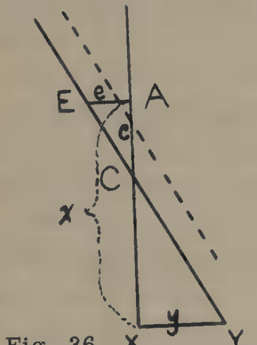

Fig. 36

Now assume the case when the straight line EY passes through A itself; it is obvious that the points C and E will fall on A, that the straight lines AC and AE, or c and e, will vanish, and that the proportion or equation $(x - c)/y = c/e$ will become $x/y = c/e$. Then in the present case, assuming that it falls under the general rule,

$x - c = x$. Yet c and e will not be absolutely nothing, since they still preserve the ratio of CX to XY, or the ratio between the entire radius and the tangent of the angle at C,[238] the angle which we assumed to remain always the same as EY approached the point A. For if c and e were nothing in an absolute sense in this calculation, in the case when the points C, E, and A coincide, c and e would be equal, since one zero equals another, and the equation or proportion $x/y = c/e$ would become $x/y = 0/0 = 1$; that is, $x = y$, which is an absurdity, since we assumed that the angle is not 45°. Hence c and e are not taken for zeros in this algebraic calculus, except comparatively in relation to x and y; but c and e still have an algebraic relation to each other. And so they are treated as infinitesimals, exactly as are the elements which our differential calculus recognizes in the ordinates of curves for momentary increments and decrements. Thus we find in the calculations of ordinary algebra traces of the transcendent differential calculus and the same peculiarities about which some scholars have scruples. Even algebraic calculation cannot avoid them if it wishes to preserve its advantages, one of the most important of which is the universality which enables it to include all cases, even that where certain given lines disappear. It would be ridiculous not to accept this and so to deprive ourselves of one of its greatest uses. All capable analysts in ordinary algebra have made use of this universality in order to make their calculations and constructions general. And when this advantage is applied to physics as well, particularly to the laws of motion, it reduces in part to what I call the *law of continuity*, which has long served me as a principle of discovery in physics and also as a convenient test to see if certain proposed rules are good. Some years ago I published an example of this in the *Nouvelles de la république des lettres*, in which I take equality as a particular case of inequality, rest as a special case of motion, parallelism as a case of convergence, etc., assuming not that the difference of magnitudes which become equal is already zero but that it is in the act of vanishing; and, similarly in the case of motion, not that it is already zero in an absolute sense but that it is on the point of becoming zero. And anyone who is not satisfied with this can be shown in the manner of Archimedes that the error is less than any assignable quantity and cannot be given by any construction. It is in this way that a mathematician, and a very capable one besides, was answered when he criticized the quadrature of the parabola on the basis of scruples similar to those now opposed to our calculus. For he was asked whether he could, by means of any construction, designate any magnitude that would be smaller than the difference he claimed existed between the area of the parabola given by Archimedes and its true area, as can always be done when the quadrature is false.

Although it is not at all rigorously true that rest is a kind of motion or that equality is a kind of inequality, any more than it is true that a circle is a kind of regular polygon, it can be said, nevertheless, that rest, equality, and the circle terminate the motions, the inequalities, and the regular polygons which arrive at them by a continuous change and vanish in them. And although these terminations are excluded, that is, are not included in any rigorous sense in the variables which they limit, they nevertheless have the same properties as if they were included in the series, in accordance with the language of infinites and infinitesimals, which takes the circle, for example, as a regular polygon with an infinite number of sides. Otherwise the law of continuity would be violated, namely, that since we can move from polygons to a circle by a continuous change and without making a leap, it is also necessary not to make a leap in passing from the properties of polygons to those of a circle.

57

ON WHAT IS INDEPENDENT OF SENSE AND OF MATTER

(Letter to Queen Sophia Charlotte of Prussia, 1702)

This and the following two selections (Nos. 58 and 59) show Leibniz's ability to popularize his ideas. The first two were certainly written at the instigation of his pupil, the Queen of Prussia, and the third, on ethics and law, belongs by style at least to the same group.

This letter of Leibniz's was probably in reply to one by John Toland, who had visited the courts of Hanover and Berlin and had there had opportunity to expound his own empiricism and materialism. In any case, Sophia Charlotte submitted a letter of Toland's to Leibniz for criticism, and a rather short and unsatisfactory correspondence between the two men followed. Leibniz's paper is at certain points clearly aimed at Toland and probably also at Locke, whose Essay he was engaged in criticizing, but who avoided being drawn into correspondence.

* * *

[G., VI, 499-508]

I found the letter truly ingenious and beautiful which was sent some time ago from Paris to Osnabrück, and which I recently read by your order at Hanover. Since it deals with two important questions on which I admit I do not entirely share the opinion of its author—whether there is something in our thoughts which does not come from sense and whether there is something in nature which is not material—I wish I were able to explain myself with the same charm as his, in order to obey Your Majesty's orders and satisfy Your Majesty's curiosity.

To use the analogy of an ancient writer, we use the external senses as a blind man uses his stick, and they help us to know their particular objects, which are colors, sounds, odors, tastes, and tactual qualities. But they do not help us to know what these sensible qualities are or in what they consist. For example, if red is the whirling of certain small globes which, it is claimed, make light; if heat is an eddy of very fine dust; if sound is made in the air as are circles in the water when a stone is thrown in, as some philosophers hold, we at least do not see this, and we cannot even understand how this whirling, these eddies and circles, if they are real, should bring about just the particular perceptions which we have of red, of heat, and of noise. So it can be said that sensible qualities are in fact occult qualities and that there must be others more manifest which could render them understandable. Far from understanding sensible things only, it is just these which we understand the least. And even though we are familiar with them, we do not understand them the better for that, just as a pilot does not understand the nature of the magnetic needle, which turns to the north, better than other men, although he has it constantly before his eyes in the compass, and as a result scarcely even has any more curiosity about it.

I do not deny that many discoveries have been made about the nature of these occult qualities. So, for example, we know what kind of refraction produces blue and yellow and how these two colors mixed produce green. But we still cannot understand as a result how the perception we have of these three colors follows from these causes. Also, we do not have even nominal definitions of such qualities, in order to explain the terms. The purpose of nominal definitions is to give marks sufficient to aid in recognizing things. For example, assayers have marks by which they distinguish gold from all other metals, and, even if a man has never even seen gold, these marks could be taught him so that he could recognize it unmistakably should he some day encounter it. But this is not the case with these sensible qualities; no mark for recognizing blue, for example, can be given to one who has never seen it. Thus blue is itself its own mark, and, in order that a man may know what blue is, one must of necessity show it to him.

For this reason it is usually said that the *concepts* of these qualities are *clear*, since they serve us in recognizing them, but that these same concepts are not *distinct*, because we cannot distinguish or develop the content included in them. It is an "I know not what" which we perceive but for which we cannot account. On the other hand, we can make someone else understand what a thing is if we have some kind of description or nominal definition, even though we do not have the thing at hand to show him. We must do justice to the senses, however, by recognizing that, besides these occult qualities, they enable us to know other qualities which are more manifest and furnish more distinct concepts. It is these which are ascribed to the *common sense*, because there is no external sense to which they are particularly attached and belong.[239] It is of these that definitions of the terms or words we use can be given. Such is the idea of *numbers* which is found alike in sounds, colors, and the qualities of touch. It is thus, too, that we perceive the *figures* which are common to colors and to qualities of touch but which we do not observe in sounds. But it is tru that, in order to conceive numbers and even shapes distinctly and to bui sciences from them, we must reach something which sense cannot furnish but which the understanding adds to it.[240]

Since therefore our soul compares the numbers and the shapes of colors, for example, with the numbers and shapes discovered by touch, there must be an *internal sense* where the perceptions of these different external senses are found united. This is called the *imagination*, which comprises at once the *concepts of particular senses*, which are *clear* but *confused*, and the *concepts of the common sense*, which are clear and distinct.[241] And these clear and distinct ideas which are subject to the imagination are the objects of the *mathematical sciences*, namely, arithmetic and geometry, which are the *pure* mathematical sciences, and their applications to nature, which make up *mixed* mathematics. It is seen also that particular sense qualities are capable of explanation and rationalization only insofar as they have a content common to the objects of several external senses and belong to the internal sense. For, whenever one tries to explain sensible qualities distinctly, one always turns back to mathematical ideas, and these ideas always include *magnitude*, or multitude of parts. It is true that the mathematical sciences would not be demonstrative but would consist of a simple induction or observation which could never assure us of the perfect generality of the truths found in it, if something higher, which only the intellect can provide, did not come to the aid of *imagination* and *sense*.

There are thus also objects of another nature, which are not at all included in what we have observed in the objects of either the particular senses or the common sense, and which consequently are also not to be considered objects of the imagination. Besides what is *sensible* and *imaginable*, therefore, there is that which is only *intelligible*, since it is the object of the understanding alone. And such is the object of my thought when I think of myself.

This thought of *myself*, who perceive sensible objects, and of my own action which results from it, adds something to the objects of sense. To think of some color and to consider that I think of it—these two thoughts are very different, just as much as color itself differs from the ego who thinks of it. And since I conceive that there are other beings who also have the right to say "I," or for whom this can be said, it is by this that I conceive what is called *substance* in general. It is the consideration of myself, also, which provides me with other concepts in *metaphysics*, such as those of cause, effect, action, similarity, etc., and even with those of *logic* and *ethics*. Thus it may be said that there is nothing in the understanding which has not come from the senses, except the understanding itself, or the one who understands.

There are thus three levels of concepts: those which are *sensible* only, which are the objects produced by each sense in particular; those which are at once *sensible and intelligible*, which appertain to the common sense; and those which are *intelligible only*, which belong to the understanding. The first and second together are imaginable, but the third lie beyond the imagination. The second and third are intelligible and distinct, but the first are confused, although they may be clear and recognizable.[242]

Being itself and *truth* are not understood completely through the senses. For it would not at all be impossible for a created being to have long and orderly dreams which resemble our lives, such that everything that it thought it perceived through the senses would be nothing but mere appearances. Something is thus needed beyond the senses, by which to distinguish the true from the apparent. But the truth of the demonstrative sciences is free[243] of such doubts and must even serve to judge the truth of sensible things. For as able ancient and modern philosophers have already well said, even if all that I think I see were only a dream, it would always be true that I who am thinking in my dream would be something and that I should in fact think in many ways for which there must always be a reason.

What the ancient Platonists have said is thus quite true and quite worthy of consideration—that the existence of intelligible things, particularly of the I who think and am called a mind or soul, is incomparably more certain than the existence of sensible things and that it would thus not be impossible, speaking with metaphysical rigor, that there should exist at bottom only intelligible substances, of which sensible things would be only the appearances. Instead, our lack of attention causes us to take sensible things for the only true ones. It is also well to observe that if I should discover some demonstrative truth, mathematical or other, in a dream (and this can in fact be done), it would be just as certain as if I were awake. This shows us that intelligible truth is independent of the truth or existence of sensible and material things outside of us.

This conception of *being* and of *truth* is thus found in the ego and in the understanding rather than in the external senses and the perception of exterior objects.

In the understanding we discover also what it means to affirm, deny, doubt, will, and act. But, above all, we find there the *force of the conclusions* in reasoning, which are a part of what is called the *natural light*. For example, by reversing the terms, one can draw from the premise that no wise man is vicious the conclusion that no vicious man is wise. On the other hand, from the premise that every wise man is praiseworthy, one cannot conclude by reversing terms that every praiseworthy man is wise, but only that some praiseworthy men are wise. Although one can always convert particular affirmative propositions, this is impossible with particular negatives. For example, if some wise men are rich, it is necessary also that some rich men are wise. Yet one can say that there are charitable beings who are not just, for this happens when charity is not regular enough, but one cannot infer from this that there are just beings who are not charitable, for charity and the rule of reason are at once included in justice.

It is by this *natural light* that one may recognize also the *axioms* of mathematics; for example, that if the same quantity is taken away from two equals the remainders are equal and likewise that if both sides of a balance are equal neither will sink, a fact which we can foresee without ever having tried it. It is upon such foundations that arithmetic, geometry, mechanics, and the other demonstrative sciences are established, in which it is true that the senses are necessary to have definite ideas of sensible things, and experience is necessary to establish certain facts and even useful in verifying the reasoning involved, by a kind of check, as it were. But the force of the demonstrations depends upon intelligible concepts and truths, for it is these alone which enable us to draw conclusions which are necessary; they even make it possible for us, in the conjectural sciences, to determine demonstratively the degree of probability in certain given assumptions, so that we may choose reasonably, among conflicting appearances, that one whose probability is the greater. But this part of the art of reasoning has not yet been cultivated as much as it ought to be.

To return to necessary truths, however, it is universally true that we know them only by this natural light and not at all by sense experiences. For the senses can indeed help us after a fashion to know what is, but they cannot help us to know what must be or what cannot be otherwise.

For example, although we have countless times tested the fact that every heavy body falls toward the center of the earth, and is not sustained freely in the air, we are not sure that this is necessary until we have grasped the reason for it. Thus we cannot be sure that the same thing would happen in an altitude a hundred leagues or more higher than we are. There are philosophers who represent the earth as a magnet whose attractive force does not, they think, extend very far, any more than the ordinary magnet attracts a needle some distance away from it. I am not saying that they are right but only that we cannot proceed with much certainty beyond the experiences which we have had, unless we are aided by reason.

It is for this reason that the geometricians have always held that what has only been proved by induction or by examples, in geometry or arithmetic, has never been perfectly proved. For example, experience teaches us that the odd numbers when added together continuously in their order produce the square numbers in order, that is, the numbers produced by multiplying a number by itself. Thus 1 and 3 make 4, that is, 2^2; and 1 and 3 and 5 make 9, that is, 3^2; and 1 and 3 and 5 and 7 make 16, or 4^2; and 1 and 3 and 5 and 7 and 9 make 25, or 5^2; and so forth.

However, if one had tried this a hundred thousand times, extending the calculation very far, one might well judge it reasonable that this will always be true, but one could never be absolutely certain of it as long as he does not grasp the demonstrative reason for it which mathematicians long ago discovered. It is on the basis of this uncertainty of induction, pushed a little too far, that an Englishman has recently tried to argue that we can avoid death. For, says he, the following conclusion is not sound: my father, my grandfather, my great-grandfather have died, and so have all the rest whom we know to have lived before us; therefore we too will die. For their death has no influence upon us. The trouble with this argument is that we resemble them a little too much, in that the causes of their death subsist in us as well. For the similarity between us would itself not be sufficient to draw conclusions of complete certainty, without considering the same reasons.

There are in fact experiments which succeed countless times in ordinary circumstances, yet instances are found in some extraordinary cases in which the experiment does not succeed. For example, if we had shown a hundred thousand times that iron sinks to the bottom when placed in water, we are still not sure that this must always happen. Without appealing to the miracle of the prophet Elisha, who made iron float, we know that an iron pot can be made so hollow that it floats and can even carry a considerable load besides, as do boats made of copper and of tinplate. Even the abstract sciences like geometry provide cases in which what ordinarily happens does not happen. Ordinarily, for example, we find that two lines which approach each other continuously finally meet, and many people would be quick to swear that it could never happen otherwise. Yet geometry does furnish exceptional lines called asymptotes for this reason, which when extended to infinity approach each other continuously, yet never meet.

This consideration also shows that there is a light which is born with us. For since the senses and induction can never teach us truths that are fully universal or absolutely necessary, but only what is and what is found in particular examples, and since we nonetheless know the universal and necessary truths of the sciences—in this we are privileged above the beasts—it follows that we have drawn these truths in part from what is within us. Thus one can lead a child to them by simple questions in the Socratic manner, without telling him anything, and without having him experiment at all about the truth of that which is asked him. This could most easily be carried out in numbers and similar matters.

I agree, however, that in our present state the external senses are necessary for our thinking and that, if we had none, we would not think. But what is necessary for something need not therefore make up its essence. The air is necessary for our life, but our life is different from air. The senses furnish us with the matter for reasoning, and we never have thoughts so abstract that something is not mixed with them from sense. But reasoning demands something more than what is sensible.

As for the second question, whether there are immaterial substances, one must first explain it in order to answer it. Heretofore matter has been understood to mean that which includes only purely passive and indifferent concepts, such as extension and impenetrability, which need to be given determinate form or activity by something else. Thus when it is said that there are immaterial substances, one means by this that there are substances which include other concepts, namely, perception and the principle of action or of change, which cannot be explained either by extension or by impenetrability. When these beings have feeling, they are called souls, and when they are capable of reason, they are called spirits. Hence if anyone says that force and perception are essential to matter, he is taking matter for the complete corporeal substance which includes form and matter, or the soul along with the organs. This is the same as if he had said that there are souls everywhere. This could be true, yet not at all contrary to the doctrine of immaterial substances. For this does not require these souls to be free from matter but only to be something more than matter and not produced or destroyed by the change which matter undergoes or subject to dissolution, since they are not composed of parts.

It must also be admitted, however, that there is some substance separate from matter. To make this clear, we need only to consider that there is an infinity of possible orders which the totality of matter might have received in place of this particular sequence of changes which it has actually taken on. For it is clear, for example, that the stars could have moved quite differently, since space and time are indifferent to every kind of motion and figure. Hence the reason, or the universal determining cause which makes things be, and makes them be as they are rather than otherwise, must of necessity be free of matter. Even the existence of matter depends upon it, since one does not find anything in the concept of matter which carries a reason for its existence with it.

Now this ultimate reason for things which is common to all and universal because of the connection between all the parts of nature is what we call God, who must of necessity be an infinite and absolutely perfect substance. I am inclined to believe that all finite immaterial substances—in the opinion of the ancient Church Fathers, even the genii or angels—are joined to organs and accompany matter and even that souls or active forms are found everywhere. And to constitute a complete substance matter cannot dispense with them, since force and action are found everywhere in it. And the laws of force depend upon certain marvelous principles of metaphysics or upon intelligible concepts and cannot be explained by material or mathematical concepts alone or by those which fall within the jurisdiction of the imagination.

Perception, too, cannot be explained by any mechanism, whatever it may be. We can conclude then that there is also something immaterial everywhere in created beings, and particularly in us, where this force is accompanied by a fairly distinct perception, and even by that light of which I have spoken above, which makes us resemble God in miniature not only through our knowledge of order but also through the order which we can ourselves impart to the things within our grasp, in imitation of that which God imparts to the universe. It is in this, also, that our *virtue* and perfection consist, as our *felicity* consists in the pleasure which we take in it.

Now whenever we penetrate to the basis of anything, we find there the most beautiful order we can desire, surpassing anything we had expected, as anyone knows who has understood the sciences. We can therefore conclude that it is the same in all the rest and that not only do immaterial substances subsist always but their lives, progress, and changes are controlled to lead to a definite end or, better, to approach it more and more, as do the asymptotes. Even though we may sometimes slip back, like curves which descend, the progression must finally prevail and win.

The natural light of reason is insufficient for us to recognize the details, and our experiences are still too limited to discover the laws of this order. Meanwhile the revealed light guides us when we heed it through faith. But there remains room to think that in the future we may know still more by experience itself and that there are spirits who already know more in this way than we.

Meanwhile philosophers and poets, lacking this knowledge, have had recourse to the fictions of metempsychosis or of the Elysian fields in order to provide some ideas which might be popularly appealing. But a consideration of the perfection of things, or, what amounts to the same thing, of the sovereign power, wisdom, and goodness of God, who does everything for the best, that is, for the greatest order, is enough to make all reasonable people content and to convince us that our contentment should be the greater in the measure in which we are inclined to follow order and reason.

58

REFLECTIONS ON THE DOCTRINE OF A SINGLE UNIVERSAL SPIRIT

1702

This work, which returns to the theme of No. 53, On Nature Itself, was written at the summer palace, Lützenburg (later Charlottenburg), near Berlin. Like the preceding, it reflects the reply which Leibniz was engaged in preparing to Locke's Essay.

* * *

[G., VI, 529-38]

Some discerning people have believed, and still believe today, that there is only one single spirit, which is universal and animates the whole universe and all its parts, each according to its structure and the organs which it finds there, just as the same wind current causes different organ pipes to give off different sounds. Thus they also hold that, when an animal has sound organs, this spirit produces the effect of a particular soul in it but that, when the organs are corrupted, this particular soul reduces to nothing or returns, so to speak, to the ocean of the universal spirit.

Aristotle has seemed to some to have had an opinion approaching this, which was later revived by Averroes, a celebrated Arabian philosopher. He believed that there is an intellectus agens, or active understanding, in us and also an intellectus patiens, or a passive understanding, and that the former, coming from without, is eternal and universal for all, while the passive understanding, being particular for each, disappears at man's death. This was the doctrine of certain Peripatetics two or three centuries ago, such as Pomponatius, Contarini, and others, and one recognizes traces of it in the late Mr. Naudé, as his letters and his recently printed Naudaeana show.[244] These men taught the doctrine in secret to their closest and ablest disciples; in public they were cautious enough to say that, though the doctrine was indeed true according to philosophy—by which they meant pre-eminently that of Aristotle—it was false from the viewpoint of faith. This finally resulted in the disputes concerning the twofold truth, a doctrine condemned in the last Lateran Council.

I have been told that Queen Christina held a strong inclination toward this opinion, and since Mr. Naude, her librarian, was saturated with it, it would seem that he gave her information about these secret opinions of famous philosophers, with whom he had discoursed in Italy. Spinoza, who recognizes only one single substance, is not far from the doctrine of a single universal spirit, and even the Neo-Cartesians, who hold that only God acts, affirm it, seemingly unawares. It would also seem that Molinos and certain other modern quietists, among them an author who calls himself John Angelus Silesius, who wrote before Molinos and some of whose writings have recently been reprinted, and even before these, Weigel, shared this opinion of a Sabbath or a repose of souls in God. It is for this reason that they believed that the cessation of particular activities is the highest state of perfection.[245]

It is true that the Peripatetic philosophers did not make this spirit completely universal, for, besides the intelligences which they held animated the stars, they also assumed an intelligence for this lower world, holding that it is this intelligence which functions as active intellect in the souls of men. They were led to this doctrine of a universal immortal soul for all men by a fallacious argument. For they assumed that an actual infinite plurality is impossible and that it is therefore also impossible that there should be an infinite number of souls but that this would necessarily follow if particular souls were to subsist. For since it is their opinion that the world is eternal and the human race also, and since new souls are constantly being born, there would have to be an actual infinity by now if they were all to subsist.

They regarded this reasoning as a demonstration. But it is full of false assumptions. There are those who disagree with them on the impossibility of an actual infinite, on the eternity of the human race, and on the generation of new souls, since Platonists teach the pre-existence of souls and Pythagoreans teach metempsychosis, holding that there always remain a certain determined number of souls which pass through cycles.

In itself the doctrine of a universal spirit is good, for all who teach it recognize in fact the existence of divinity, whether they believe that this universal spirit is supreme—in which case they hold that it itself is God—or whether they believe, like the Cabalists, that God created it. The latter is also the opinion of the Englishman Henry More and other newer philosophers, particularly of certain chemists who believe that there is a universal *Archeus* or world-soul; some of them have maintained that this is the spirit of the Lord moving over the waters, of which the beginning of Genesis speaks.[246]

But to go so far as to say that this universal spirit is the only spirit and that there are no particular souls or spirits, or at least that these particular souls cease to subsist, is, I believe, to exceed the bounds of reason and to advance, without any basis, a doctrine of which we have not even a distinct concept. Let us examine briefly the apparent reasons upon which the attempt is made to support this doctrine which destroys the immortality of souls and degrades the human race, or, rather, all living creatures, from the level on which they belong and which is commonly ascribed to them. For it seems to me that so important an opinion should be proved and that it is not enough merely to have an imaginary notion of it based in fact only upon a very lame comparison with the wind animating musical organs.

I have shown above that the supposed demonstration of the Peripatetics, who maintained that there is only one spirit common to all men, has no force but is supported entirely by false premises. Spinoza undertook to demonstrate that there is only one substance in the world, but his demonstrations are pitiful or unintelligible. And the Neo-Cartesians, who believe that only God acts, have hardly given a proof, not to mention that Father Malebranche seems to admit at least the internal action of particular spirits.

One of the most obvious arguments that have been urged against particular souls is the difficulty involved in their origin. The Scholastic philosophers held great disputes about the origin of forms, among which they included souls. Their opinions were sharply divided as to whether they were drawn forth from the potency of matter, like a figure worked out of marble [eduction], or whether there was a traduction of souls, so that a new soul is born from a preceding one as one fire is lighted from another, or whether souls had already pre-existed and merely made themselves known after the generation of the body, or, finally, whether souls were created by God whenever there was a new generation.

Those who denied particular souls believed that, by doing so, they were escaping the whole difficulty, but they were really cutting the knot rather than untying it. There is no force at all in an argument which can be put as follows: There have been differing explanations of this doctrine; therefore, the whole doctrine is false. That is the way the skeptics reason, and, if it were acceptable, there would be almost nothing which one could not reject. Experiments in our own time lead us to believe that souls, and even animals, have always existed, although in minute size, and that generation is but a kind of augmentation. In this way all the difficulties connected with the generation of souls and forms disappear. We do not deny God the right to create new souls, however, or to give a higher degree of perfection to those already in nature. We are rather speaking only of what is ordinary in nature without entering into God's particular economy with respect to human souls, which may be privileged because they are infinitely above those of animals.

A factor which, in my opinion, has also contributed much to make intelligent men accept the doctrine of a single universal spirit is that the popular philosophers gave currency to a doctrine about separate souls and about soul functions separate from and independent of the body and its organs which they could not fully justify. They had a good reason in wanting to sustain the immortality of the soul as conforming to divine perfections and to true morality; but, seeing that the organs observed in animals become disordered through death and are finally destroyed, they felt obliged to return to separate souls, that is, to believe that the soul subsists without any body yet does not cease having its thoughts and functions. The better to prove this, they tried to show that the soul already has thoughts in this life which are abstract and independent of material concepts. But those who rejected this separate state and independence as contrary to experience and to reason were thereby driven all the more to believe in the extinction of the individual soul and the conservation of the single universal spirit.

I have examined this matter carefully and have shown that there are in truth certain materials of thought or objects of the understanding in the soul which have not been furnished by the external senses, namely, the soul itself and its functions (nihil est in intellectu quod non fuerit in sensu, nisi ipse intellectus).[247] Those who favor a universal spirit will readily assent to this, for they distinguish this spirit from matter. I find, however, that there is never any abstract thought which is not accompanied by some images or material traces, and I have established a perfect parallelism between what happens in the soul and what takes place in matter. I have shown that the soul with its functions is something distinct from matter but that it nevertheless is always accompanied by material organs and also that the soul's functions are always accompanied by organic functions which must correspond to them and that this relation is reciprocal and always will be.

As for the complete separation of soul and body, I can say nothing about the laws of grace, and about the ordinances of God in regard to human souls in particular, beyond what the Holy Scriptures say, since these are things which cannot be known by reason, being dependent on the revelation of God himself. Nevertheless, I see no reason, either religious or philosophical, which compels me to abandon the doctrine of the parallelism of soul and body and to admit a perfect separation. For why cannot the soul always retain a subtle body organized after its own manner, which could even some day reassume the form of its visible body in the resurrection, since a glorified body is ascribed to the blessed, and since the ancient Fathers have ascribed a subtle body to angels?

Furthermore, this doctrine conforms with the order of nature established through experience, for the observations of very capable observers have convinced us that animals do not begin when they are popularly believed to begin and that seminal animals or living seeds have existed from the beginning of things.[248] And both order and reason demand that what has existed since the beginning should no more have an end and that, since generation is thus merely the growth of a changed and developed animal, death will be nothing but the diminution of a changed and developed animal but that the animal itself will always remain throughout these transformations, just as the silkworm and the butterfly are one and the same animal. And it is appropriate to remark here that nature has this tact and goodness in revealing its secrets to us in small samples and thus making us infer the rest, everything being in correspondence and harmony. It is this which nature shows us in the transformation of caterpillars and other insects, for flies too come from worms, to help us grasp that there are transformations everywhere. Our experiments on insects have destroyed the popular notion that these animals are reproduced through nourishment, without propagation. Nature has likewise also given us, in birds, a sample of how all animals are generated by means of eggs, a fact which the new discoveries have now made us accept.

There are also microscopic observations which have shown that the butterfly is merely a development of the caterpillar, but especially that seeds already contain the formed plant or animal, although it still needs transformation and nourishment, or growth, to become an animal of the kind which our ordinary senses can observe. And since even the smallest insects reproduce by the propagation of their kind, one must conclude the same to be true for these little seminal animals, that is, that they themselves come from other still smaller seminal animals, and thus have originated only with the world. This agrees well with the Holy Scriptures, which suggest that there were seeds in the beginning.

In dreams and in unconsciousness nature has given us an example which should convince us that death is not a cessation of all functions but only a suspension of certain more noticeable ones. Elsewhere I have explained an important point whose neglect has led men the more easily to accept the opinion that the soul is mortal. It is that a large number of small perceptions which are equal and balanced among themselves, with nothing to give them relief or distinguish them from each other, are not noticed at all and cannot be remembered. But to conclude from this that the soul is without any function at all would be like the popular belief that there is a void or nothing at all wherever there is no noticeable matter or that the earth does not move because its movement, being uniform and without jerks, is unnoticeable. We have an infinity of little perceptions which we are incapable of distinguishing. A great stupefying roar, as, for example, the murmur of a large assemblage, is composed of all the little murmurs of individual persons which are not noticed at all but of which one must nevertheless have some sensation; otherwise one would not sense the whole. Thus when an animal is deprived of organs capable of giving it sufficiently distinct perceptions, it does not follow that the animal has left no smaller and more uniform perceptions or that it is deprived of all its organs and all its perceptions. Its organs are merely enveloped and reduced to a small volume, but the order of nature requires that everything be developed again sometime and return to a noticeable state and that there be a definite well-regulated progression in its changes which helps to bring things to fruition and perfection. It seems that even Democritus noted this resuscitation of animals, for Plotinus ascribed a doctrine of resurrection to him.[249]

These considerations all show that not only particular souls but animals themselves subsist and that there is no reason for believing in a complete extinction of souls or even a complete destruction of the animal. As a result, therefore, there is no need to have recourse to a single universal spirit and to rob nature of its own particular and subsisting perfections; thus also failing in fact adequately to recognize its order and harmony. There are also many things in the doctrine of a single universal spirit which cannot be maintained and are involved in much greater difficulties than the common doctrine.

These are a few of them. One may see at once that the analogy of the wind which makes different pipes sound differently flatters the imagination but explains nothing or, rather, that it implies exactly the contrary. For this universal wind in the pipes is nothing but the sum of a number of individual winds. So each pipe is filled with its own air, which can even pass from one pipe into another, in a way which makes the analogy support, instead, particular souls and even the transmigration of souls from one body to another, as the air can change pipes.

Moreover, if one imagines the universal spirit to be like an ocean composed of an infinity of drops which become detached when they animate some particular organic body but are reunited to the ocean after the organs are destroyed, one again forms a materialistic and crude concept which does not fit the matter and is involved in the same difficulties as those of the wind. For, since the ocean is an aggregate of drops, God would be an assemblage of all souls, almost in the same way that a swarm of bees is an assemblage of small animals. But this swarm is not in itself a true substance, and it is clear that on this basis the universal spirit would not in itself be a true being. Instead of saying, then, that God is the only spirit, we should have to say that he is nothing at all by himself and that there are in nature only the particular souls of which he is the aggregate.

Besides, the drops reunited to the ocean of universal spirit after the destruction of the organs would in fact be souls which were subsisting independently of matter. So we would fall back into the view which we sought to avoid, especially if these drops retain some trace of their preceding state or still have certain functions and could perhaps even acquire more sublime ones in this ocean of divinity or of the universal spirit. But if we mean that these souls reunited to God are without any other functions of their own, we fall into an opinion contrary to reason and to all sound philosophy, as if any subsisting being could ever reach a state in which it is without any function or impression whatever. For, when one thing is joined to another, it does not cease to have its particular functions, but these joined to the functions of others result in the functions of the whole. The whole would have none if the parts had none.

Furthermore, I have shown elsewhere that each being preserves perfectly all the impressions which it has received, although these impressions may no longer be noticeable separately because they have been joined with others. Thus the soul, reunited with an ocean of souls, would always remain the particular soul which it had been separately.

This shows that it is more reasonable and in greater conformity with the habits of nature to keep particular souls subsisting in animals themselves, and not outside of them in God, and so to conserve not merely the soul but also the animal, as I have explained above and elsewhere; thus particular souls would also remain on duty always, that is, they would retain the particular functions which belong to them and would contribute to the beauty and order of the universe, instead of being reduced to the Sabbath in God of the quietists, or to a state of idleness and uselessness. As for the beatific vision of blessed spirits, it is compatible with the functions of their glorified bodies, which will continue to be organic in their own manner.

If anyone tries to maintain, however, that there are no particular souls at all, not even now, since the functions of sensation and thought take place with the help of organs, he is refuted by our experience, which teaches, it seems to me, that we are in ourselves something particular which thinks, which perceives, and which wills, and that we are distinguished from another being who thinks and wills something else. Otherwise we fall into the opinion of Spinoza or some similar authors who hold that there is only one substance, God, who thinks, believes, and wills one thing in me, but who thinks, believes, and wills an entirely contrary thing in someone else, an opinion which Mr. Bayle has well held up to ridicule in certain passages of his Dictionary.[250]

To go further, if there is nothing in nature but the universal spirit and matter, we shall have to say that, if it is not the universal spirit who believes and wills contrary things in different persons, it is matter which is different and acts differently. But, if matter acts, of what good is the universal spirit? If matter is only a passive first principle or, better, a purely passive being, how then attribute these actions to it? It is far more reasonable, then, to believe that besides God, who is the supreme active principle, there are numerous particular active beings, since there are numerous actions and passions which are particular and contrary and should not be ascribed to the same subject. And these active beings are none other than individual souls.

It is also known that there are degrees in all things. There is an infinity of degrees between motion of any kind whatever and perfect rest, between hardness and perfect fluidity without any resistance, between God and nothing. Thus there is likewise an infinity of degrees between an active being as great as it can be and pure passivity. It is unreasonable, therefore, to recognize only a single active being, that is, a universal spirit, and a single passive one, that is, matter.

We must consider also that matter is not something opposed to God but that it must rather be opposed to a limited active being, that is, to the soul or to the form. For God is the supreme being, opposed to nothingness; from him comes matter as well as forms, and the purely passive is something more than nothingness, since it is capable of something, whereas nothingness can have no attributes. So we must match each particular portion of matter with particular forms, that is to say, with the souls and spirits which correspond to it.

I do not wish to return here to a demonstrative argument which I have used elsewhere, which is drawn from the nature of unities or simple things, with which particular souls are included. This argument compels us, unavoidably, not merely to admit particular souls but also to affirm that they are immortal by their nature and as indestructible as the universe and, what is more, that each soul is a mirror of the universe in its own way, without any interruption, and contains in its depths an order corresponding to that of the universe itself, which the souls vary and represent in an infinite number of ways, all different and all true. Thus they multiply the universe, so to speak, as often as possible, and in such a way that they approach divinity as far as they can in their different degrees and give to the universe all the perfection of which it is capable.

Consequently, I cannot see any basis, either in reason or in appearance, for combating the doctrine of individual souls. Those who do it agree that what is in us is an effect of the universal spirit. But the effects of God have subsistence, not to say that even the modifications and effects of created beings have permanence in some way and that their impressions are merely joined together without destroying each other. If therefore, as we have seen, it is in conformity with both reason and experience for the animal to subsist always, with its more or less distinct perceptions and with certain organs, and if, as a result, this effect of God always subsists in these organs, why should it not be permissible to call this the soul and to say that this effect of God is an immaterial and immortal soul which in some way imitates the universal spirit? Especially since this doctrine puts an end to all difficulties, as I have made fully clear in what I have said here and in other writings dealing with these matters?

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REFLECTIONS ON THE COMMON CONCEPT OF JUSTICE

1702(?)

Though conclusive evidence for the date of this work, in French, is lacking, it is obviously in Leibniz's courtly style, and the allusion to the three queens (p. 927) in whom the Electress Sophia was directly interested suggests that it was written for her at some time between the determination of the Hanoverian succession to the English throne and the death of the Queen of Prussia in 1705. Not only is it a clear development of Leibniz's theory of justice and its application to government, but it contains clues to his theory of values, proposals for scientific co-operation, and a popular statement of his theodicy. His indictment of slavery is more vigorous than in No. 43, IV, and earlier writings, and Whig principles find expression in his justification of the people's right to resist the sovereign in extraordinary cases.

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[Mollat, pp. 41-70]

It is generally agreed that whatever God wills is good and just. But there remains the question whether it is good and just because God wills it or whether God wills it because it is good and just; in other words, whether justice and goodness are arbitrary or whether they belong to the necessary and eternal truths about the nature of things, as do numbers and proportions. The former opinion has been held by certain philosophers and by theologians, both Roman and Reformed. But the Reformed theologians of today usually reject this teaching, as do also all our own theologians and most of those of the Roman church as well.

As a matter of fact it would destroy the justice of God. For why praise him for acting justly if the concept of justice adds nothing to his act? And to say, *Stat pro ratione voluntas*—"Let my will stand for the reason"—is definitely the motto of a tyrant. Moreover, this opinion would hardly distinguish God from the devil. For if the devil, that is, an intelligent, invisible power who is very great and very evil, were the master of the world, this devil or this god would still be evil even if we were forced to honor him, just as certain peoples honor imaginary gods of this kind in the hope of bringing them to do less evil. Consequently, some people, overly devoted to the absolute right of God, have believed that he could justly condemn innocent people and even that this may actually happen. This does violence to those attributes which make God love-worthy and destroys our love for God, leaving only fear. Those who believe, for example, that infants who die without baptism are cast into the eternal flames must in effect have a very weak idea of the goodness and the justice of God and thus thoughtlessly injure what is most essential to religion.

The Sacred Scriptures also give us an entirely different idea of this sovereign substance, speaking, as they so often and so clearly do, of the goodness of God and presenting him as a person who justifies himself against complaints. In the story of the creation of the world, the Scripture says that God considered all that he had done and found it good; that is, he was content with his work and had reason to be so. This is a human way of speaking which seems to be used explicitly to point out that the goodness of the acts and products of God does not depend on his will but on their nature. Otherwise he would only have to see what he willed and did to determine if it is good and to justify himself to himself as a wise sovereign. All our theologians, therefore, and most of those of the Roman church, as well as the ancient Church

Fathers and the wisest and most esteemed philosophers, have favored the second view, which holds that goodness and justice have grounds independent of will and of force.

In his dialogues Plato introduces and refutes a certain Thrasymachus who tried to explain what justice is by a definition which, if acceptable, would strongly support the view which we are opposing.[251] That is just, he says, which suits or pleases the most powerful. If this were true, the sentence of a sovereign court or a supreme judge would never be unjust, nor would an evil but powerful man ever deserve condemnation. What is more, the same action could be just and unjust depending on the judges who decide, which is ridiculous. It is one thing to *be* just, another to *pass* for just and to take the place of justice.

A celebrated English philosopher named Hobbes, who has a reputation for his paradoxes, has tried to maintain almost the same thing as Thrasymachus.[252] He holds that God has the right to do anything because he is all-powerful. This fails to distinguish between *right* and *fact*. For what *can* be is one thing; what *ought* to be is another. This same Hobbes believes, for almost the same reason, that the true religion is that of the state.[253] It would follow that if the emperor Claudius, who decreed in an edict that "in libera re publica crepitus atque ructus liberos esse debere,"[254] had established the god Crepitus among the authorized gods, he would have been a true god worthy of worship.

This amounts to saying, in concealed terms, that there is no true religion and that religion is merely an invention of men. And in the same vein, the remark that justice is that which pleases the most powerful is nothing but saying that there is no certain and determined rule of justice which prevents our doing what we wish to do and can do with impunity, however evil it may be. Thus treason, assassination, poisoning, the torture of innocents, would all be just if they succeeded. This is essentially to change the meaning of terms and to speak a language different from that of other men. Until now we have meant by justice something different from that which always prevails. We have believed that a happy man can be evil and that an unpunished act can nevertheless be unjust, that is, it may deserve punishment, so that the issue is solely to know why it deserves punishment, without raising the question of whether the punishment will actually follow or not, or whether there is any judge to impose it.

There were once two tyrants in Sicily named Denis, father and son. The father was more evil than the son. He had established his tyranny by destroying many honorable men. His son was less cruel but more addicted to disorders and luxuries. The father was happy and kept himself in power; the son was overthrown and finally made himself schoolmaster at Corinth in order to have the pleasure of ruling always and of carrying a scepter, after a fashion at least, by wielding the switches used in punishing the children. Should we say that the actions of the father were more just than those of the son because he was happy and unpunished? Would such a view permit history to condemn a happy tyrant? We see too, every day, that men, whether interested or disinterested, complain of the actions of certain powerful people and find them unjust. So the question is only whether they have reason to complain and whether history can justly blame the inclinations and acts of any prince. If this be granted, we must acknowledge that men mean something else by justice and right than that which pleases a powerful being who remains unpunished because there is no judge capable of mending matters.

In the universe as a whole, or in the government of the world, it is fortunately true that he who is the most powerful is at the same time just and does nothing against which anyone has a right to complain. We must hold for certain that, if we understood that universal order, we should find it impossible to do anything better than he has done it. Yet his power is not the formal reason which makes him just. Otherwise, if power were the formal reason for justice, all powerful beings would be just, each in proportion to his power, which is contrary to experience.

We must therefore search after this formal reason, that is, the "wherefore" of this attribute or the concept which should teach us what justice is and what men mean when they call an act just or unjust. And this formal reason must be common to God and man. Otherwise we should be wrong in seeking to ascribe the same attribute to both without equivocation. These are fundamental rules for reasoning and discourse.

I grant that there is a great difference between the way in which men are just and the way in which God is just, but this difference is only one of degree. For God is perfectly and entirely just, while the justice of men is mixed with injustice, with faults and sins, because of the imperfection of human nature. The perfections of God are infinite; ours are limited. Anyone, therefore, who tries to maintain that the justice and goodness of God have entirely different rules from those of men must at the same time admit that two entirely different concepts are involved and that to ascribe justice to both is either deliberate equivocation or gross self-deceit. But if we choose one of the two concepts as the proper conception of justice, it must follow either that there is no true justice in God or that there is none in man, or perhaps that there is none in either God or man, so that in the end we do not know what we are talking about when we speak of justice. This would in effect destroy justice and leave nothing but the name, as do those who make it arbitrary and dependent on the whim of a judge or ruler, since the same act will appear just and unjust to different judges.

This is somewhat as if we should try to maintain that our science—for example, arithmetic, or the science of numbers—does not agree with the science of God or the angels, or perhaps that all truth is arbitrary and based on a whim. For example, 1, 4, 9, 16, 25, etc., are square numbers produced by multiplying 1, 2, 3, 4, 5, etc., by themselves. Thus 1 times 1 is 1; [illegible] times 2 is 4; 3 times 3 is 9, etc. We discover that the successive odd numbers are the differences between successive square numbers. Thus the difference between 1 and 4 is 3, that between 4 and 9 is 5, between 9 and 16 is 7, etc. . . . Now would one have any reason to maintain that this is not true for God and the angels and that they see or discover something in numbers entirely contrary to what we find in them? Would we not be right in laughing at a man who maintained this and who did not know the difference between eternal and necessary truths, which must be the same for all, and truths that are contingent and changeable or arbitrary?

This same thing is true about justice. If it is a fixed term with determinate meaning—in a word, if it is not a simple sound without sense, like blitiri—the term or word justice will have some definition or intelligible meaning. And, by using the incontestable rules of logic, one can draw definite consequences from every definition. This is precisely what we do in building the necessary and demonstrative sciences which do not depend at all on facts but solely on reason; such are logic, metaphysics, arithmetic, geometry, the science of motion, and the science of Right [droit] as well, which are not at all based on experience or facts but serve rather to give reasons for facts and to control them in advance. This would be true in regard to Right, even if there were no law [loi] in the world.[255] The error of those who have made justice depend upon power comes in part from their confusion of Right with law. Right cannot be unjust; this would be a contradiction. But law can be, for it is power which gives and maintains law; and, if this power lacks wisdom or good will, it can give and maintain very bad laws. But happily for the world, the laws of God are always just, and he is in a position to maintain them, as he without a doubt does, even though this has not always happened visibly and at once—for which he assuredly has good reasons.

We must determine, then, the formal principle of justice and the measure by which we should judge acts to know if they are just or unjust. After what has been said we can already foresee what this must be. Justice is nothing but what conforms to wisdom and goodness combined. The end of goodness [bonté] is the greatest good [bien]. But to recognize this we need wisdom, which is merely the knowledge of the good, as goodness is merely the inclination to do good to all and to prevent evil, at least if evil is not necessary for a greater good or to prevent a greater evil. Thus wisdom is in the understanding, and goodness is in the will, and as a result justice is in both. Power is another matter. But if power is added, it brings to pass the Right and causes that which should be to exist really as well, insofar as the nature of things permits. And this is what God does in the world.

But since justice aims at the good, and wisdom and goodness together form justice and so refer to the good, we may ask what is the true good. I reply that it is merely whatever serves the perfection of intelligent substances. It is obvious, therefore, that order, contentment, joy, wisdom, goodness, and virtue are goods in an essential sense and can never be bad and that power is a good in a natural sense, that is, by itself, because, other things being equal, it is better to have it than not to have it. But power does not become an assured good until it is joined with wisdom and goodness. For the power of an evil man serves only sooner or later to plunge him further into misery, since it gives him the means of doing more evil and of earning a greater punishment, from which he will not escape, since the universe has a perfectly just monarch whose infinite penetration and sovereign power one cannot avoid.

Since experience shows us that God, for reasons unknown to us but surely very wise and based on a greater good, permits many evil persons to be happy in this life and many good persons to be unhappy, a fact which would not conform to the rules of a perfect government such as God's if it had not been corrected, it follows necessarily that there will be another life and that souls will not perish with the visible bodies. Otherwise there would be crimes unpunished and good deeds unrewarded, which is contrary to order.

There are demonstrative proofs, besides, of the immortality of the soul, for the principle of action and of consciousness could not derive from a purely passive extended thing indifferent to all motion, as is matter. Therefore action and consciousness must necessarily come from something simple or immaterial, without extension and without parts, which is called the soul. But whatever is simple and without parts is not subject to dissolution and, as a result, cannot be destroyed. There are people who imagine that we are too small a thing in the sight of an infinite God for him to be concerned about us. It is thought that we are to God as are the worms which we crush without thinking, in relation to us. But this is to imagine that God is like man and that he cannot think of everything. God, according to this reasoning, being infinite, does things without work in a way that results from his will, just as it results from my will and that of my friend that we are in accord, without needing some action to produce the accord after our resolutions are made. But if mankind, or even the smallest thing, were not well governed, the whole universe would not be well governed, for the whole consists of its parts.

We also find order and wonders in the smallest whole things when we are capable of distinguishing their parts and at the same time of seeing the whole, as we do in looking at insects and other small things in the microscope. There are thus the strongest reasons for holding that the same craftsmanship and harmony would be found in great things if we were capable of seeing them as a whole. Above all, they would be found in the whole economy of the government of spirits, which are the substances most similar to God because they are themselves capable of recognizing and inventing order and craftsmanship. As a result we must conclude that the Author of things who is so inclined to order will be concerned for those creatures who are naturally sources of order in the measure of their perfection and who are alone capable of imitating his workmanship. But it is impossible that this should seem so to us, in this small portion of life which we live here below, which is but a small bit of the life without bounds which no spirit can fail to achieve. To consider this bit separately is to consider things like a broken stick or like the bits of flesh of an animal taken separately, so that the craftsmanship of its organs cannot be made apparent.

This is also true when one looks at the brain, which must undoubtedly be one of the greatest wonders of nature, since it contains the most immediate organs of sense. Yet one finds there only a confused mass in which nothing unusual appears but which nevertheless conceals some kind of filaments of a fineness much greater than that of a spider's web which are thought to be the vessels for that very subtle fluid called the animal spirits. Thus this mass of brain contains a very great multitude of passages—and of passages too small for us to overcome the labyrinth with our eyes, whatever microscope we may use. For the subtlety of the spirits contained in these passages is equal to that of light rays themselves. Yet our eyes and our sense of touch show us nothing extraordinary in the appearance of the brain.

We may say that it is the same in the government of intelligent substances under the kingship of God, in which everything seems confused to our eyes. Nevertheless, it must be the most beautiful and most marvelous arrangement of the world, since it comes from an Author who is the source of all perfection. But it is too great and too beautiful for spirits with our present range to be able to perceive it so soon. To try to see it here is like wishing to take a novel by the tail and to claim to have deciphered the plot from the first book; the beauty of a novel, instead, is great in the degree that order emerges from very great apparent confusion. The composition would thus contain a fault if the reader could divine the entire issue at once. But what is only suspense [curiosité] and beauty in novels, which imitate creation, so to speak, is also utility and wisdom in this great and true poem, this word-by-word creation, the universe. The beauty and justice of the divine government have been hidden in part from our eyes, not only because it could not be otherwise without changing the entire harmony of the world, but also because it is proper in order that there may be more exercise of free virtue, wisdom, and a love of God which is not mercenary, since the rewards and punishments are still outwardly invisible and appear only to the eyes of our reason or faith. This I find to be a good thing here, since the true faith is based on reason. And since the wonders of nature show us that God's operations are admirably beautiful whenever we can envisage a whole in its setting, even though this beauty is not apparent when we consider things detached or torn from their whole, we must likewise conclude that all that we cannot yet disentangle or envisage as a whole with all its parts must no less have justice and beauty. To recognize this point is to have a natural foundation for faith, hope, and the love of God, since these virtues are based on a knowledge of the divine perfections.

Now nothing better corroborates the incomparable wisdom of God than the structure of the works of nature, particularly the structure which appears when we study them more closely with a microscope. It is for this reason, as well as because of the great light which could be thrown upon bodies for the use of medicine, food, and mechanical ends, that it should be most necessary to push our knowledge further with the aid of microscopes. There are scarcely ten men in the world who are carefully at work on this, and, if there were a hundred thousand, there would not be too many to discover the important wonders of this new world which makes up the interior of ours and which is capable of making our knowledge a hundred thousand times greater than it is. It is for this reason that I have more than once hoped that the great princes might be led to arrange for this and to induce men to work at it. Observatories have been founded for watching the stars, whose structures are spectacular and demand great apparatus, but telescopes are far from being as useful and from revealing the beauties and varieties of knowledge which microscopes reveal. A man in Delft has accomplished wonders at it, and, if there were many others like him, our knowledge of physics would be advanced far beyond its present state. It behooves great princes to arrange this for the public welfare, in which they are most interested. And since this matter involves little cost and display, is very easy to direct, and needs very little but good will and attention to accomplish it, there is little reason to neglect it. As for me, I have no other motive in recommending this research than to advance our knowledge of truth and the public good, which is strongly interested in the increase of the treasure of human knowledge.

Most of the questions of Right, but especially of the right of sovereigns and nations, are confused because they do not agree on a common conception of justice, with the result that we do not understand the same thing by the same word, and this opens the way to endless dispute. Everyone would agree, perhaps, on this nominal definition—that justice is a constant will to act in such a way that no person has reason to complain of us. But this is not enough unless the method is given for determining these reasons. Now I observe that some people restrict the reasons for human complaints very narrowly and that others extend them. There are those who believe that it is enough if no harm is done to them and if no one has deprived them of their possessions, holding that no one is obligated to seek the good of others or prevent evil for them, even if it should cost us nothing and give us no pain. Many who pass in the world for great judges keep themselves within these limits. They content themselves with harming no one, but they are not inclined to improve people's conditions. In a word, they believe one can be just without being charitable.

There are others in the world who have greater and more beautiful views and who would not wish anyone to complain of their lack of goodness. They would approve what I have said in my preface to the Codex juris gentium[256]—that justice is the charity of the wise man, that is, a goodness toward others which ought to conform to wisdom. And wisdom, in my opinion, is nothing but the knowledge of happiness. Men may be permitted to vary in their use of words, and, if anyone wants to insist on limiting the term just to what is the opposite of charitable, there is no way to force him to change his language, since names are arbitrary. Yet we have a right to learn the reasons which he has for being what he calls just, in order to see whether these same reasons will not bring him also to be good and to do good.

I believe we will agree that those who are charged with the conduct of others, like tutors, the directors of societies, and certain magistrates, are obligated not merely to prevent evil but also to secure the good. But it might perhaps be questioned whether a man free from commitments, or the sovereign of a state, has such obligations, the former in relation to others involved in the situation, the latter in relation to his subjects.

On top of this I shall ask that whoever can sustain a person must not do evil to others. One can give more than one reason for this. The most pressing will be the fear that someone will do the same thing to us. But are we not also subject to the fear that men will hate us if we refuse them aid which does not at all inconvenience us and if we neglect to prevent an evil which is about to crush them? Someone may say, "I am content that others should not harm me. I do not ask at all for their aid and their good deeds and have no wish either to give or to claim more." But can one sincerely maintain this? Let him ask himself what he would say or hope for if he should find himself actually on the point of falling into an evil which someone could help him avoid by a turn of his hand? Would one not hold him for a bad man and even for an enemy if he refused to save us in such a situation? . . . It will be granted, then, that one ought to prevent evil for another if it can be done conveniently. But perhaps it will not be granted that justice orders us to do positive good to others. I now ask if one is not at least obligated to relieve others' ills. And I return again to the proof, that is, to the rule, quod tibi non vis fieri.[257] Suppose that you were plunged into misery. Would you not complain about someone who did not help you, if he could easily do so? You have fallen into the water. If he refuses to throw a rope to you to give you a way of saving yourself, would you not judge him to be an evil man and even an enemy? Suppose that you suffered from violent pains and that someone had in his house, under his lock and key, a healing fountain capable of relieving your ills. What would you say and what would you do if he refused to give you a few glasses of its water?

Led by degrees,[258] people will agree not only that men ought to abstain from doing evil but also that they ought to prevent evil from being done and even to alleviate it when it is done, at least as far as they can without inconvenience to themselves. I am not now examining how far this inconvenience can go. Yet it will still be doubted, perhaps, that one is obligated to secure the good of another, even when this can be done without difficulty. Someone may say, "I am not obligated to help you achieve. Each for himself, God for all." But let me again suggest an intermediate case. A great good comes to you, but an obstacle arises, and I can remove that obstacle without pain. Would you not think it right to ask me to do so and to remind me that I would ask it of you if I were in a similar plight? If you grant this point, as you can hardly help doing, how can you refuse the only remaining request, that is, to procure a great good for me when you can do this without inconvenience of any kind to yourself and without being able to offer any reason for not doing it except a simple, "I do not want to"? You could make me happy, and you refuse to do so. I complain, and you would complain in the same circumstances; therefore, I complain with justice.

This gradation shows us that the same grounds for complaint subsist throughout. Whether one does evil or refuses to do good is a matter of degree, of more or less, but this does not alter the nature of the matter. It can also be said that the absence of the good is an evil and the absence of the evil a good. In general, if someone asks you to do something or not to do something, and you refuse his request, he has reason to complain if he can judge that you would make the same request if you were in his place. And this is the principle of equity or, what is the same thing, of equality or of the identity of reasons, which holds that one should grant to others whatever one would himself wish in a similar situation, without claiming any privilege contrary to reason or without claiming to be able to allege one's will as a reason.

Perhaps we can say, then, that not to do evil to another, *neminem laedere*, is the precept of the Law which is called *strict Right* [*jus strictum*] but that *equity* demands that one also do good when this is fitting and that it is in this that the precept consists which orders us to give each one his due, *suum cuique tribuere*. But what determines fitness [*convenance*] or what each one is due can be known by the rule of equity or of equality: *quod tibi non vis fieri aut quod tibi vis fieri, neque aliis facito aut negato.*[259] This is the rule of reason and of our Master. Put yourself in the place of another, and you will have the true point of view to judge what is just or not.

Certain objections have been made against this great rule, but they come from the fact that it is not applied universally. For example, it has been objected that by virtue of this maxim a criminal can claim a pardon from the sovereign judge because the judge would wish the same thing if he were in a similar position. The reply is easy. The judge must put himself not only in the place of the criminal but also in that of the others whose interest lies in the crime being punished. And he must determine the greater good in which the lesser evil is included. The same is true of the objection that distributive justice demands an inequality among men, that a society ought to divide gains in proportion to what each has contributed, and that merit and lack of merit must be considered. Here the reply is also easy. Put yourself in the place of all and assume that they are well informed and enlightened. You will gather this conclusion from their votes: they will regard it fitting to their own interest that distinctions be made between one another. For example, if profits were not divided proportionally in a commercial society, some would not enter it at all, and others would quickly leave it, which is contrary to the interest of the whole society.

We may say, then, that *justice*, at least among men, is the constant will to act as far as possible in such a way that no one can complain of us if we would not complain of others in a similar situation. From this it is evident that, when it is impossible to act so that the whole world is satisfied, we should try to satisfy people as much as possible. What is just thus conforms to the charity of the wise man.

So wisdom, which is a knowledge of our own good, brings us to justice, that is to say, to a reasonable advance toward the good of others. So far we have proposed as a reason for this the fear that we will be harmed if we do otherwise. But there is also the hope that others will do the same for us. Nothing is surer than the proverbs, *homo homini deus, homo homini lupus.*[260] Nothing can contribute more to the happiness, or to the misery, of man than men themselves. If they were all wise and knew how to treat each other, they would all be happy, as far as happiness can be obtained by human reason. But we may be permitted to use fictions for a better insight into the nature of things. Assume a person who has nothing to fear from others; such a person as would be a superior power in relation to men—some higher spirit; some substance which pagans would have called a divinity; some immortal, invulnerable, invincible man—in short, a person who can neither hope for nor fear anything from us. Shall we say that such a person is nonetheless obligated to do us no harm and even to do us good? Mr. Hobbes would say "No." He would even add that this person would have an absolute right in making us his conquest, because we could not complain of such a conqueror on the grounds which we have just pointed out, since there is another condition which exempts him from all consideration for us. But without needing a fiction, what shall we say of the supreme divinity whom reason makes us recognize? Christians agree, and others should agree, that this great God is supremely just and supremely good. But it cannot be for his own repose or to maintain peace with us that he shows us so much goodness, for we should be unable to wage war against him. What then is the principle of his justice, and what is its law? It cannot be this equity or equality which exists among men and makes them envisage the common end of our human condition, "to do unto others what we wish others to do unto us."

One cannot envisage any other motive in God than that of perfection or, if you like, of his pleasure. Assuming, according to my definition, that pleasure is nothing but the feeling of perfection, he has nothing to consider outside of himself; on the contrary, everything depends upon him. But his happiness would not be supreme if he did not aim at as much good and perfection as possible. But what will you say if I show that this same motive is found in truly virtuous and generous men, whose highest function is to imitate divinity so far as human nature is able? The earlier reasons of fear and hope can bring men to be just in public and when necessary for their own interest. They will even obligate them to exercise and practice the rules of justice from childhood in order to acquire habits, out of fear of betraying themselves too easily, and so harming themselves along with others. Yet if there were no other motive, this would merely be political at bottom. And if someone who is just in this sense should find opportunity to make a great fortune through a great crime which would remain unknown, or at least unpunished, he would say as did Julius Caesar, following Euripides:

> Si violandum est jus, regnandi gratia
> Violandum est.[261]

But he whose justice is proof against such a temptation cannot have any motive but that of his own inclination, acquired by birth or exercise and regulated by reason, which makes him find so much pleasure in the practice of justice and so much ugliness in unjust acts that other pleasures and displeasures are compelled to give way.

One can say that this serenity of spirit, which finds the greatest pleasure in virtue and the greatest evil in vice, that is, in the perfection and imperfection of the will, would be the greatest good of which man is capable here below, even if he had nothing to expect beyond this life. For what can be preferred to this internal harmony, this continual pleasure in the purest and greatest, of which one is always master and which one need never abandon? Yet it must also be said that it is difficult to attain this disposition of spirit and that the number of those who have achieved it is small, most men remaining insensible to this motive, great and beautiful though it be. This seems to be why the Siamese believed that those who attain this degree of perfection receive divinity as a reward. The goodness of the Author of things has therefore provided for it through a motive more nearly within the reach of all men, by making himself known to the human race, as he has done by the eternal light of reason which he has given us and by the wonderful effects which he has placed before our eyes of his power, wisdom, and infinite goodness. This knowledge should make us see God as the sovereign Monarch of the universe, whose government is the most perfect state conceivable, in which nothing is neglected, in which all the hairs on our heads are counted, in which everything right becomes a fact, either in itself or in some equivalent form, in such a way that justice coincides with the good pleasure of God and no divorce ever arises between the honorable [l'honnête] and the useful. After this it must be imprudent not to be just, because, according as he is just or unjust, a man will certainly experience good or bad for himself from what he has done.

But there is something still more beautiful than all this in the government of God. What Cicero has said allegorically of ideal justice is really true in reference to this substantial justice—that, if we could see it, we should be inflamed by its beauty.[262] One can compare the divine Monarchy to a kingdom whose sovereign would be a queen more spiritual and more learned than Queen Elizabeth; more judicious, more happy, and, in a word, greater than Queen Anne; cleverer, wiser, and more beautiful than the Queen of Prussia—in short, as accomplished as it is possible to be.[263] Conceive that the perfections of this queen make such an impression upon the minds of her subjects that it is their greatest pleasure to obey and to please her. In this case the whole world would be virtuous and just by inclination. It is this which occurs literally and beyond all description in relation to God and to those who know him. It is in him that wisdom, virtue, justice, and grandeur are accompanied by sovereign beauty. One cannot know God as one should without loving him above all things, and one cannot love him thus without willing what he wills. His perfections are infinite and cannot cease. This is why the pleasure which consists in the feeling of his perfections is the greatest and most durable possible; that is, it is the greatest felicity. And that which causes one to love him at the same time makes one happy and virtuous. . . .

This shows that justice can be taken in different ways. It can be opposed to charity, and then it is only the *jus strictum*. It can be opposed to the wisdom of him who must exercise justice, and then it conforms to the general good, but there will be cases in which the particular good will not be found in it. God and immortality would not enter into account. When one considers them, however, one always finds his own good in the general good.

While justice is merely a particular virtue, moreover, when we leave out of consideration God or a government which imitated that of God, and while this virtue so limited includes only what is called commutative and distributive justice, it can be said that as soon as it is based on God or on the imitation of God it becomes *universal justice* and contains all the virtues. For when we are vicious not only do we harm ourselves but we also diminish, so far as depends on us, the perfection of the great state of which God is the monarch. And although the evil is in fact redressed by the wisdom of the sovereign Lord this is partly through our punishment. Universal justice is distinguished by the supreme precept—*honeste (hoc est probe, pie) vivere*; as *suum cuique tribuere* conforms to particular justice, whether in general or taken more narrowly as the distributive justice which distinguishes men in particular; and as *neminem laedere* stands for commutative justice or for *jus strictum* as opposed to equity, as one takes these terms.[264]

It is true that Aristotle has recognized this universal justice, though he has not related it to God; even so, I find it beautiful that he had so lofty an idea.[265] But a well-formed government or state takes the place of God on earth for him, and this government will do what it can to require men to be virtuous. But as I have already said, one cannot compel men to be always virtuous by the principle solely of self-interest in this life; even less can one find the rare secret of lifting them up so that virtue constitutes their greatest pleasure, in the way I have just finished describing. Aristotle seems to have hoped for this rather than shown it. Yet I do not find it impossible that there should be times and places where one attains this, especially if piety is added.

We can still distinguish *jus strictum*, equity, and piety when we are considering the right of sovereigns and of peoples. Hobbes and Filmer seem to have considered only *jus strictum*.[266] The Roman jurisconsults also sometimes adhere to this level of right alone. It can even be said that piety and equity regularly demand the *jus strictum* when they do not supply an exception to it. In insisting upon *jus strictum*, however, one must always add, "except for the demands of equity and of piety." Otherwise the proverb would hold: *summum jus summa est injuria*.[267]

In examining the *jus strictum*, it is important to consider the origin of kingdoms or states. Hobbes seems to think that men were something like beasts at first and became more tractable little by little but that, as long as they were free, they were in a state of war of all against all and thus had no *jus strictum*, since each had a right in everything and was able, without injustice, to seize the possessions of his neighbor as he saw fit. For there was then no security or judge, and anyone had the right to forestall those whom one had grounds to fear greatly. But, as this state of crude nature was a state of misery, men agreed upon the means to secure their safety, transferring their right to judge to the person of the state, represented by an individual or by some assembly.[268] However, Hobbes acknowledges somewhere that a man has not, for this reason, lost the right to judge what is most agreeable to him and that a criminal is allowed to do what he can to save himself. But the citizens of a state must submit to the judgment of the state.[269] The same author must also recognize, however, that these same citizens, who have not lost their power of judgment, also cannot let their own safety be endangered in some situation where many of them are mistreated.[270] So in the end, in spite of what Hobbes says, each one has retained his right and his liberty regardless of the transfer to the state, and this transfer will be provisional and limited, that is, it will take place to the degree that we believe our safety is involved. The reasons which this illustrious author gives to prevent subjects from resisting their sovereign are nothing but plausible considerations based on the true principle that ordinarily such a remedy is worse than the evil itself. But what is ordinarily the case is not absolutely so. The one is like the jus strictum, the other like equity.

It seems to me also that this author makes the mistake of confusing right with its factual application. A man who has acquired a good, who has built a house or forged a sword, is the proprietary master of it, although someone else, in time of war, has the right to drive him from his house and to take away his sword. And although there are cases where one cannot enjoy his right for want of a judge and of enforcement, the right does not cease to subsist. To try to destroy something because there is no way at once to prove it and to enjoy it is to confuse matters.

Mr. Filmer seems to me to have recognized rightly that there is a right, even a jus strictum, before the foundation of states. Whoever produces something new or gains possession of something already existing but which no one has possessed before, and improves and adapts it to his use, cannot as a rule be deprived of it without injustice. This is also true if one acquires a thing from such an owner, either directly or through intermediates. The right of acquisition is a jus strictum which even equity approves. Hobbes believes that by virtue of this right children are the property of their mother unless society orders differently, and Filmer, assuming the superiority of the father, gives him the right of property over his children as well as over the children of his slaves. Since all men from the beginning until now are, according to sacred history, descended from Adam and also from Noah, it follows, according to Filmer, that if Noah were living, he would have the right of an absolute monarch over all men. In his absence fathers always are, or should be, the sovereign masters of their descendants. This paternal power is the origin of kings, who replace progenitors, in the last analysis, either by force or by consent. And, since the power of fathers is absolute, that of kings is absolute also.

This conception ought not entirely to be condemned, but I think we can say that it has been pushed too far. We must admit that a father or a mother acquires a great power over children by their procreation and education. But I do not think that we can conclude from this that children are the property of their progenitors, as are the horses or dogs which are born to us and the works which we create. The objection may be raised that we can acquire slaves and that the children of slaves are also slaves. And according to the law of nations, slaves are the property of their masters, and no reason can be seen why children whom we have produced and nurtured by education should not be our slaves by an even juster title than those whom we have bought or captured.

To this I reply that even if I were to agree that there is a right of slavery among men which conforms to natural reason, and that according to jus strictum the bodies of slaves and their infants are under the power of their masters, it will always be true that another stronger right opposes the abuse of this one. This is the right of reasonable souls, which are naturally and inalienably free. It is the Law of God who is the sovereign master of bodies and souls and under whom masters are the fellow-citizens of their slaves, since slaves have the right of citizenship in the kingdom of God as well as their masters. So it can be said that a man's body is the property of his soul and ought not to be taken from him as long as he lives. Since a man's soul cannot be acquired, neither can ownership of his body be acquired, so that the right of a master over his slave can be in the nature only of what is called servitude to another, or a kind of usufruct. But usufruct has its limits; it must be practiced without destroying itself, *salva re,* so that this right cannot be extended to the point of making a slave evil or unhappy. But even if I were to agree, contrary to the nature of things, that an enslaved man is the property of another man, the right of the master, however rigorous, would be limited by *equity*, which demands that one man shall care for another as he would wish another to care for himself in a similar situation, and by *charity*, which orders us to work for the happiness of others. And these obligations are perfected by *piety,* that is, by what we owe to God. If we wished to stop with *jus strictum* alone, the American cannibals would have a right to eat their prisoners. There are those among them who demand even more; they use their prisoners to have children, then fatten and eat the children, and afterward, when she produces no more, the mother. Such are the consequences of a pretended right of masters over slaves and of fathers over children. . . .

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REPLY TO THE THOUGHTS ON THE SYSTEM OF PRE-ESTABLISHED HARMONY CONTAINED IN THE SECOND EDITION OF MR. BAYLE'S CRITICAL DICTIONARY, ARTICLE RORARIUS

1702

The second edition of the *Dictionnaire historique et critique* appeared in 1702, with an additional criticism of Leibniz's system attached as note L to the article on "Rorarius." The reply which Leibniz prepared the same year was sent to John Bernoulli and De Volder on August 19 and forwarded by the latter to Bayle, who returned it to Leibniz along with a letter now lost. Leibniz published his paper in Masson's *Histoire critique de la république des lettres* in 1702 with the title given above. Leibniz's position is the same as that of the De Volder correspondence but directed to the explanation of body-and-soul processes; the reconciliation of mechanism and "idealism" (this term itself appears) is particularly clear.

* * *

[G., IV, 554-71]

In June and July, 1695, I had published in the *Journal des savants* of Paris several essays on a new system which seemed to me adapted to explain the union of soul and body.[271] Instead of the Scholastics' theory of influence and the Cartesians' theory of assistance, I have there made use of the theory of *pre-established* harmony. Mr. Bayle, who is able to impart to the most abstract meditations the charm which they need to attract the attention of readers, but who at the same time penetrates to their depths and brings them into clear light, took the pains to enrich this system by the comments which he inserted in his Dictionary in the article on Rorarius. But since he at the same time also discussed some difficulties which he held to be in need of clarification, I tried to do justice to these in the Histoire des ouvrages des savants for July, 1698.[272] To this Mr. Bayle has just replied in the second edition of his Dictionary, in the same article on Rorarius, page 2610, note L. He says, most honorably, that my replies have strengthened my position and that, if the possibility of the hypothesis of pre-established harmony were well established, he would find no difficulty in preferring it to the Cartesian hypothesis, because it gives a noble idea of the Author of things and removes every concept of miraculous guidance in the ordinary course of nature.

He still seems to find it difficult, however, to conceive that this pre-established harmony is possible. To show this, he begins with something which, in his opinion, is easier but which will nonetheless be found very implausible. He compares my hypothesis, namely, with the assumption of a ship which arrives at a desired port all by itself without any guidance. On this he says that we must admit that the infinity of God is not too great to communicate such a faculty to a ship. He does not assert absolutely that the thing is impossible, yet he does judge that others will so consider it, for "you yourself will admit (he adds) that the nature of a ship is incapable of receiving this particular faculty from God." Perhaps he believes that, according to the hypothesis in question, we must think of God giving the ship, for this result, a faculty in the Scholastic sense, like that which the Schools ascribed to heavy bodies to draw them toward the center. If it is in this sense that he understands the doctrine, I am the first to reject this assumption. But if he means a faculty of the ship which can be explained by the laws of mechanics and by internal forces as well as by external circumstances, and still rejects this assumption as impossible, I should like him to give some reason for this judgment. For though I have no need of the possibility of something entirely resembling this ship in the way in which Mr. Bayle seems to think of it (as I shall show later), I still believe that, when things are well considered, there is not only no difficulty involved from God's viewpoint, but it seems that there could even be a finite spirit skilful enough to bring this about. There is no doubt whatever that a man could make a machine capable of walking about for some time through a city and of turning exactly at the corners of certain streets. A spirit incomparably more perfect, though still finite, could also foresee and avoid an incomparably greater number of obstacles. This is so true that, if this world were nothing but a composite of a finite number of atoms which move in accordance with the laws of mechanics, as the hypothesis of some thinkers holds, it is certain that a finite spirit could be so enlightened as to understand and to foresee demonstratively everything which would occur in a determinate time, so that this spirit not only could construct a ship capable of sailing by itself to a designated port, by giving it the needed route, direction, and force at the start, but could also form a body capable of counterfeiting a man. For this involves merely a matter of more or less, which does not alter matters in the realm of possibilities. However great may be the number of functions of a machine, the power and skill of the builder could increase proportionately in such a way that not to see this possibility would be to give insufficient consideration to the degrees of things. It is true that the world is not compounded of a finite number of atoms but is rather like a machine composed in each of its parts of a truly infinite number of forces. But it is also true that he who made it and who governs it has an even more infinite perfection, because it comes from an infinity of possible worlds which are in his understanding and from which he has chosen that which pleased him. To return to limited spirits, however, we can judge from the small examples which sometimes occur among us how far those which we do not know may extend their powers. For example, there are men capable of carrying out great arithmetical calculations at once and solely by thinking. M. de Monconis mentions such a man in Italy in his day, and there is now one in Sweden who never learned even the ordinary arithmetic, and whom, I hope, they will not neglect to sound out concerning his mode of procedure. And what is man, however excellent he is capable of being, in comparison with all the many possible, or even existing, creatures such as angels or genii, who could surpass us in every kind of understanding and reasoning incomparably more than these wonderful possessors of a natural arithmetic surpass us in the matter of numbers?

I admit that people do not commonly consider these matters; they are confused by objections when they have to think of what is unusual or even of that of which we have no instance. But when we think of the greatness and variety of the universe, we judge entirely differently about it. Mr. Bayle especially cannot fail to see the justice of these conclusions. It is true that my hypothesis does not depend upon them, as I will show directly, but even if it did, and if one were right in saying that it is even more surprising than the hypothesis of automata (of which, as I shall show below, it carries forward only the good parts and what is sound), I should not be disturbed, granted that there were no other method of explaining things in conformity to the laws of nature. For in these matters we ought not to be guided by popular concepts to the injury of conclusions that are certain. Besides, the objection which a philosopher should make against automata does not lie in the wonderfulness of the assumption but in the failure of principles, since entelechies are necessary everywhere, and we hold a small idea of the Author of nature (who multiplies his little worlds or his active indivisible mirrors as much as he can) when we give them only to human bodies. It is even impossible for them not to be everywhere.

So far we have spoken only of what a limited substance can do;

in reference to God the matter is entirely different. Far from that which at first seemed impossible really being so, in his case we must rather say that it is impossible for God to have used any other way, being as he is infinitely powerful and wise and in everything preserving as much order and harmony as is possible. What is more, though this seems so strange when considered by itself, it is a certain consequence of the constitution of things, so that the universal wonder, so to speak, destroys and absorbs the particular wonder, since it provides a reason for it. For everything is so controlled and bound together that these infallible machines of nature, which are comparable to ships that would arrive at port by themselves in spite of all obstacles and storms, ought not to be considered any stranger than a rocket which glides along a string or a liquid which runs through a tube. Furthermore, since bodies are not atoms but are divisible, and are indeed divided to infinity, and everything is full of them, it follows that the very smallest body receives some impression from the slightest change in all the others, however distant and small they may be, and must thus be an exact mirror of the universe. The result is that a sufficiently penetrating spirit could, in the measure of his penetration, see and foresee in each corpuscle everything which has happened and will happen in that corpuscle and everything which has happened and will happen everywhere both within and outside of the corpuscle. So nothing happens to it, not even by the impact of surrounding bodies, which does not follow from what is already internal to it and which can disturb its order. This is still more obvious in the simple substances or in the active principles themselves, which I follow Aristotle in calling primitive entelechies, and which nothing can disturb, in my opinion. This is my reply to a marginal note of Mr. Bayle (p. 2612, b) in which he makes the objection that since an organic body is

composed of many substances, each of which has a principle of action that is really distinct from the principle of each of the others, and since the action of each principle is spontaneous, this should vary the effects unto infinity. And the impact of neighboring bodies should add some constraint to the natural spontaneity of each.

But we must take into consideration the fact that each one has already been adapted to every other one from all time and responds to what the others demand of it. Thus there is no constraint in substances, except externally and in appearance. This is so true that the motion of any point whatever in the world takes place in a line strictly determined in nature, which this point has taken once for all and which nothing can ever make it abandon.

This is the most exact and clear explanation which I can give, I believe, for those who are geometrically minded, although the kinds of curves infinitely exceed those which a finite mind can grasp. It is true that, if there could be but this one point in the world, its line would be straight, but that now it is the result, by virtue of the laws of mechanics, of the concourse of all bodies; it is also by this very concourse that it is pre-established. Thus I acknowledge that the spontaneity is not properly to be found in the mass (short of the universe in its entirety, to which there is no resistance). For if this point could begin to be by itself, it would continue, not in the pre-established curve, but in the straight line tangent to it. So it is properly in the *entelechy*, of which this point is the point of view, that spontaneity is found. And while the point can have by itself only a tendency to move in a line tangent to this curve, because it has no memory or presentiment, so to speak, the entelechy expresses the pre-established curve itself, since the surrounding bodies cannot have any influence upon this soul or entelechy, so that in this sense there can be no violence with respect to it. What is commonly called violence, however, does occur insofar as this soul has confused, and therefore involuntary, perceptions.[273]

All this shows, finally, that the wonders of a ship which guides itself to port without a pilot, or of a machine which carries out the functions of man without having intelligence, and who knows what other fictions which can be presented in objection to my view and which make my assumptions appear absurd when considered separately, offer no more difficulties. It shows too that, when we recognize that things are determined or inclined to what they ought to do, all the strangeness found in my view completely disappears. Everything which ambition or any other passion makes the soul of Caesar do is represented in his body as well, and the movements of these passions all come from impressions of objects joined to internal movements. The body is made in such a way that the soul never makes any resolutions to which the movements of the body do not correspond; even the most abstract reasonings play their part in this by means of the characters which represent them to the imagination. In a word, so far as the details of phenomena are concerned, everything takes place in the body as if the evil doctrine of those who believe, with Epicurus and Hobbes, that the soul is material were true, or as if man himself were only a body or an automaton. These materialists have thus extended to man as well what the Cartesians have held regarding all other animals, having shown in fact that nothing is done by man, with his whole reason, which is not a play of images, passions, and motions in the body. Those who have tried to prove the contrary have, by persisting in this bias, merely dishonored themselves and prepared the basis for error to triumph. The Cartesians have had poor success (a little like Epicurus with his declination of atoms, which Cicero so ably ridiculed) in trying to maintain that the soul cannot give motion to the body but that it can nevertheless give it its direction. But neither the one nor the other can or ought to take place, and the materialists have no need to resort to this, so that nothing which appears outside of man may succeed in refuting their teaching. This suffices to establish a part of my hypothesis. Those who point out to the Cartesians that their way of proving that beasts are only automatons tends at length to support the view that it is possible, metaphysically speaking, for all other men except themselves also to be simple automatons, have said exactly and precisely what I need in order to prove the half of my hypothesis which concerns the body. But in addition to the general principles which establish the monads, of which compound things are merely the results, internal experience refutes the Epicurean doctrine. This experience is the consciousness within us of this Ego which perceives the things occurring in the body. And since perception cannot be explained by figures and movements, it establishes the other half of my hypothesis and makes us recognize an indivisible substance in ourselves which must itself be the source of its phenomena. According to this second half of my hypothesis, therefore, everything occurs in the soul as if there were no body, just as everything occurs in the body as if there were no soul according to the first half. And reason makes us conclude that other men have the same prerogative as we. Besides, I have frequently shown with regard to bodies themselves that, although there are mechanical reasons for the details of phenomena, the final analysis of the laws of mechanics and the nature of substances compels us to resort to active indivisible principles. And the wonderful order which prevails here shows us that there is a universal principle whose intelligence is supreme as well as his power. Since it seems from this that there is something good and sound in the false and evil teaching of Epicurus, to the effect that there is no need to say that the soul changes the impulses of the body, we can readily conclude also that it is just as unnecessary to assume that the material mass sends thoughts to the soul through the influence of some unknown kind of chimerical "species" such as is proposed by the Scholastics, or that God must always be the interpreter of the body to the soul, any more than he needs always to interpret the decisions of the soul to the body, as the Cartesians have held. The pre-established harmony is a good interpreter of each to the other. This shows that our view combines what is good in the hypothesis of both Epicurus and Plato, of both the greatest materialists and the greatest idealists, and that there is nothing surprising here except only the supreme perfection of the ruling principle, which is now shown in its works to be far above all that we have believed until now. What wonder, then, that everything goes well and with precision, since all things work together and lead each other by the hand, if we first assume that the whole has been perfectly thought out. It would rather be the greatest of all wonders or, better, the strangest of absurdities, if this vessel, designed to go so well, if this machine whose route has been plotted for all time, should fail in spite of the measures which God has taken. Our hypothesis with respect to corporeal mass should therefore not be compared to a vessel which brings itself to port but to the ferry boats which are attached to a cable across the river. It is like the theatrical machines and fireworks whose regularity we no longer find strange when we know how everything is done. It is time to transfer our admiration from the work to its inventor, just as we now see that the planets do not need to be guided by intelligences.

So far we have discussed almost nothing but the criticisms concerned with body or matter, and there remains no further difficulty that has been raised than that of the miracles, however beautiful, orderly, and universal they may be, which must occur in bodies in order that they may be in agreement with each other and with souls. In my opinion this should be understood as a proof rather than as an objection, at least by those persons who esteem as they ought "the power and the intelligence of the divine art," to quote Mr. Bayle, who also admits "that one can imagine nothing which gives a nobler idea of the intelligence and the power of the Author of all things."

Now we must come to the soul, where Mr. Bayle still finds difficulties, even after my efforts to resolve his first ones. He begins by comparing this soul, alone and taken by itself, receiving nothing from without, with an atom of Epicurus surrounded by the void. And I do in fact regard souls, or rather monads, as the atoms of substance, since there are no material atoms in nature according to my view, and the smallest particle of matter still has parts. Since an atom such as Epicurus imagined has a moving force which gives it a certain direction, it will carry out this direction without hindrance and uniformly if it encounters no other atom. So it seems to Mr. Bayle that the soul also, being of a nature such that nothing from without can change it, should always retain a feeling of pleasure once it has felt it. For, while the entire cause remains, the effect must always remain. If I protest that the soul must be considered as in a state of change, so that the entire cause does not remain, Mr. Bayle will reply that this change should be like the change of an atom which moves continuously in the same straight line at a uniform speed. And if he were to agree to the transformation of thoughts (so he says), it would at least be necessary for the passage which I maintain exists from one thought to another to contain some reason for the connection. I am in agreement with the basis of these objections, and I myself use them to explain my system. The state of the soul, like that of the atom, is a state of change, a tendency. The atom tends to change its place, the soul to change its thoughts; each changes by itself in the simplest and most uniform way which its state permits. Then how does it come, I will be asked, that there is such simplicity in the change of the atom, and such variety in the changes of the soul? It is because the atom (as it is assumed to be, although there is no such thing in nature), though it has parts, has nothing which causes some variety in its tendency, because we assume that its parts do not change their relations. The soul, on the other hand, though entirely indivisible, involves a composite tendency, that is to say, a multitude of present thoughts, each of which tends to a particular change according to what it involves and what is found in it at the time by virtue of its essential relationship to all the other things in the world. Among other things, it is also their lack of this relationship which bans the atoms of Epicurus from nature. For each thing or part of the universe must point to all the rest, in such a way that the soul, as concerns the variety of its modifications, must be compared, not with a material atom, but with the universe which it represents according to its point of view—and in some ways even with God himself, whose infinity it represents finitely, because of its confused and imperfect perception of the infinite. The thought of pleasure seems to be simple, but it is not, and anyone who studies its anatomy will find that it involves everything that surrounds us and therefore everything which surrounds our environment. And the reason for the change of thoughts in the soul is the same as that of the change of things in the universe which it represents. The mechanical reasons which are developed in the bodies are united and concentrated, so to speak, in the souls or entelechies; indeed, they have their source there. It is true that not all the entelechies are, like our soul, images of God, for they are not all made to be members of a society or of a state of which he is the head. But they are always images of the universe. They are after their manner worlds in abridged form, fruitful simplicities, substantial unities, but virtually infinite by the multitude of their modifications, centers which express an infinite circumference; and they are necessarily so, as I once explained them in letters exchanged with Mr. Arnauld.[274] Their duration cannot embarrass anyone any more than the duration of the atoms of Gassendi's followers. For the rest, it is often but a step from pleasure to pain, as Socrates observed in Plato's Phaedo in speaking of a man scratching himself; "grief occupies the extremes of joy" [extrema gaudii luctus occupat].[275] So one need not be surprised at this transition; pleasure seems sometimes to be only a composite of little perceptions, each of which would be a grief if it were great.

Mr. Bayle has already acknowledged that I have tried to reply to a good part of his criticisms and admits also that in the system of occasional causes it is necessary for God to be the executor of his own laws, whereas in my system the soul does this. But he objects that the soul has no instruments for such execution. I reply, as I have replied, that it does; they are the present thoughts from which future thoughts are born, and one can say that in the soul, as indeed everywhere, the present is great with the future. I believe that Mr. Bayle will agree, and all philosophers with him, that our thoughts are never simple and that with regard to certain thoughts the soul has the power to pass by itself from one to the other, as when it goes from premises to the conclusion or from the end to the means. Even Father Malebranche agrees that the soul has internal voluntary actions. What reason, then, to deny that this is the case in all our thoughts? Perhaps because it is believed that confused thoughts are entirely different in kind from distinct ones, whereas they are merely less distinguishable and less developed because of their multiplicity. The result is that certain movements, rightly called involuntary, have been ascribed to the body in such a way that nothing is believed to correspond to them in the soul; and, reciprocally, it is believed that certain abstract thoughts are not represented at all in the body. But there is an error in both of these views, as usually happens in such distinctions, because we notice only what is most apparent. The most abstract thoughts are in need of some sense perception. And when we consider what these confused thoughts are which are never absent from even the most distinct thoughts which we can have—as, for example, those of colors, odors, tastes, heat, cold, etc.—we recognize that they always involve the infinite and not only that which takes place in our body but also, by means of it, that which happens outside of it. Thus they serve our purpose here even better than would the legion of substances of which Mr. Bayle speaks as an instrument which seems necessary for the functions which I have given to the soul. It is true that the soul has these legions at its service, but not inside itself. For there is no soul or entelechy which is not dominant with respect to an infinity of others which enter into its organs, and the soul is never without an organic body which fits its present state. It is therefore these present perceptions, along with their regulated tendency to change in conformity to what is outside, which form the musical score which the soul reads. "But," says Mr. Bayle, "must not the soul recognize the sequence of the notes (distinctly), and so actually think of them?" I answer "No"; it suffices that the soul has included them in its confused thoughts in the same way that it has a thousand things in its memory without thinking of them distinctly. Otherwise every entelechy would be God, if it were distinctly conscious of the whole infinite which it includes. For God expresses everything perfectly all at once—possible and existent, past, present, and future. He is the universal source of all, and the created nomads imitate him as much as it is possible for created beings to do so. He has made them sources of their phenomena, which contain relationships to everything, more or less distinct according to the degrees of perfection which the individual substances contain. Where then is the impossibility? It seems rather that it would have to be this way in order that creatures may be made to approach God as nearly as is reasonably possible. I should like to see some positive argument pointing to a contradiction or to a conflict with some known truth. To say that the view is surprising is no objection. On the contrary, everyone who recognizes immaterial and indivisible substances also attributes to them a multitude of simultaneous perceptions and a spontaneity in their reasoning and their voluntary acts. Thus I am only extending this spontaneity to confused and involuntary thoughts too and showing that it is their nature to include relations to everything outside of them. How prove that this cannot be, or that everything that is in us must necessarily be known distinctly by us? Is it not true that we cannot always remember even what we know, and then all of a sudden come upon it by a small chance reminiscence? And what a variety of matters we can carry in the soul, even when we are unable to discover them quickly. Otherwise the soul would be a God, whereas it must suffice for it to be a little world. But this world is found to be as imperturbable as the great world, when we consider that there is spontaneity in the confused as well as in the distinct. In another sense, however, we are justified in speaking, as did the ancients, of that which consists of confused thoughts, where there is an element of the involuntary and unknown, as perturbations or passions. Hence the common usage is not wrong in speaking of a conflict between body and spirit, since our confused thoughts represent the body or the flesh and constitute our imperfection.

After having recorded this answer, which I have already given in substance—that confused perceptions include all external things and contain an infinity of relations—Mr. Bayle does not refute it. He says instead that "when this hypothesis is well developed, it is the true means of solving all the difficulties," and he honors me by saying that he hopes that I will thoroughly solve his own. Even if he had said this only out of politeness, I should have spared no efforts to do so, and I believe I have overlooked none of his questions; if I have neglected anything without trying to offer a solution, it is because I have been unable to see where the difficulty lay which he sought to raise. It is this which sometimes gives me the greatest trouble in my reply. I should like to see why he thinks that this multitude of perceptions which I assume in an indivisible substance is impossible. For I believe that it would be permissible to assume them even if our experience and common opinion did not make us recognize a great variety in our soul. It is no proof of the impossibility of a matter merely to say that one cannot understand this thing or that without pointing out wherein it violates reason, and when the difficulty is only in sense perception, and there is none in the understanding.

It is a pleasure to have to do with an opponent who is at once as just and as profound as Mr. Bayle, who is so fair that he often foresees my replies. This he has done in observing that my opinion, that the primitive constitution of each spirit is different from that of all the others, cannot seem any more extraordinary than what the Thomists hold, following their master, concerning the specific differences among all separate intelligences. I am happy to agree with him in this, for I have somewhere cited this same authority.[276] It is true that, consistent with my own definition of a species, I do not call this difference specific, for, since I believe that no two individuals ever resemble each other perfectly, I should have to say that no two individuals belong to the same species, which would not be accurate. I regret that I have not yet been able to see the objection which Dom Francis Lami made, as Mr. Bayle informs me, in his second treatise On the Cognition of Self (ed. 1699),[277] or I should also be replying to them. Mr. Bayle has explicitly sought to spare me all the objections common to my system and others; for this too I am indebted to him. I shall only say that, as concerns the force given to creatures, I think I have replied, in the Leipzig journal for September, 1698, to all the objections contained in a memoir which a scholarly man published in the same journal in 1697, and which Mr. Bayle cites in the margin, letter S.[278] I think I have even demonstrated there that without an active force in the body there would be no variety in phenomena, which amounts to the same thing as there being nothing at all. It is true that my learned adversary replied to this (May, 1699), but he really only further explained his own opinion without adequately touching upon the reasons which I opposed to it. As a result, he did not remember to reply to this demonstration, especially since he considered it futile to try to arrive at an agreement or to clarify this matter further; he even regarded it as capable of injuring our mutual understanding. I admit that this is commonly the result of such debates, but there are exceptions, and this discussion between Mr. Bayle and myself seems to be of another kind. For my part, I try always to take proper measures to preserve moderation and to push forward the clarification of problems, so that the dispute will not only be harmless but may even become fruitful. I do not know if I have achieved this last aim, but, although I cannot flatter myself to give entire satisfaction to a mind as penetrating as Mr. Bayle's in a matter as difficult as the present one, I shall always be content if he finds that I have made some progress in so important an investigation.

I have been unable to prevent myself from renewing the pleasure I once had in reading, with particular attention, a number of articles from his excellent and rich Dictionary, among others those concerned with philosophy, like the articles on the Paulicians, Origen, Pereira, Rorarius, Spinoza, and Zeno. I was surprised anew at the fecundity, force, and brilliance of his thoughts. No ancient academician, not even Carneades, could have brought out the difficulties better. Although Mr. Foucher was most able in such studies,[279] he does not approach these, and I myself find nothing in the world more useful in solving these same old difficulties. It is this that pleases me so in the criticisms of able and moderate persons, for I feel that they give me new powers, like Antaeus hurled to earth in the fable. If I speak with some confidence, it is because my own views have become fixed only after my considering all sides and weighing them well, so that I can perhaps say, without vanity, omnia praecepi atque animo mecum peregi.[280] But criticisms put me back on the track and save me much trouble, for it is no small matter to have to retrace all the bypaths to anticipate and foresee everything that others may find to criticize, inasmuch as our points of view and inclinations are so different that there have been very penetrating persons who have accepted my hypothesis from the start and even urged it upon others, while other very able men have pointed out to me that they have in fact already held this view, and still others have even said that they understand the hypothesis of occasional causes in this same sense and cannot distinguish it from mine, which well satisfies me. But I am no less pleased when I see someone set out to examine it as it should be done.

To say something about the articles of Mr. Bayle which I have just mentioned and whose subject matter has many connections with this question, it seems that the reason for permitting evil rests in the eternal possibilities, in accordance with which this kind of universe which allows evil and has admitted it to actual existence is found to be more perfect, considering the whole, than all other possible kinds. But we go astray in trying to show in detail the value of evil in revealing the good, as the Stoics do—a value which St. Augustine has well recognized in general, and according to which we step back, so to speak, in order to leap forward better.[281] For can we enter into the infinite particulars of the universal harmony? If it were necessary, however, to choose reasonably between the two, I should always favor the Origenists and never the Manichees.[282]

It does not seem necessary to me to deny action or force to creatures on the pretext that they would be creators if they produced their modifications. For it is God who conserves and continuously creates their forces, that is, who establishes a source of changing modifications in the creatures, or a state by which we can conclude that there will be a change of their modifications. Otherwise I find, as I have shown in the work cited above, that God would produce nothing and that there would be no substances beyond his own—a view which would lead us back into all the absurdities of Spinoza's God. It also seems to me that Spinoza's error comes entirely from his having pushed too far the consequences of the doctrine which denies force and action to creatures.

I acknowledge that time, extension, motion, and the continuum in general, as we understand them in mathematics, are only ideal things—that is, they express possibilities, just as do numbers. Even Hobbes has defined space as a phantasm of the existent. But to speak more accurately, *extension* is the order of possible coexistence, just as *time* is the order of possibilities that are inconsistent but nevertheless have a connection. Thus the former considers simultaneous things or those which exist together, the latter those which are incompatible but which we nevertheless conceive as all existing; it is this which makes them successive. But space and time taken together constitute the order of possibilities of the one entire universe, so that these orders—space and time, that is—relate not only to what actually is but also to anything that could be put in its place, just as numbers are indifferent to the things which can be enumerated. This inclusion of the possible with the existent makes a continuity which is uniform and indifferent to every division. It is true that perfectly uniform change, such as the mathematical idea of motion, is never found in nature any more than are actual figures which possess in full force the properties which we learn in geometry, because the actual world does not remain in this indifference of possibilities but arises from the actual divisions or pluralities whose results are the phenomena which are presented in practice and which differ from each other down to their smallest parts. Yet the actual phenomena of nature are arranged, and must be, in such a way that nothing ever happens which violates the law of continuity, which I introduced into philosophy and first mentioned in Mr. Bayle's Nouvelles de la république des lettres,[283] or any of the other most exact rules of mathematics. On the contrary, things can be rendered intelligible only by these rules, for they alone are capable, along with the rules of harmony or perfection which the true metaphysics provides, of leading us to the reasons and intentions of the Author of things. The result of this very great multitude of infinite compositions is that we are finally lost and are forced to stop in our application of metaphysical principles, and of mathematical ones as well, to physics. Yet these applications are never in error, and, when a miscalculation appears after an exact chain of inference, it is because we cannot adequately examine the facts and because there is an imperfection in our assumption. We are even more able to advance in this application to the degree that we are able to make use of our thoughts of infinity, as our newest methods have shown us. Although mathematical thinking is ideal, therefore, this does not diminish its utility, because actual things cannot escape its rules. In fact, we can say that the reality of phenomena, which distinguishes them from dreams, consists in this fact. However, mathematicians do not need all these metaphysical discussions, nor need they embarrass themselves about the real existence of points, indivisibles, infinitesimals, and infinites in any rigorous sense. In my reply to a notice in the Mémoires de Trévoux for May and June, 1701, which Mr. Bayle cites in the article on Zeno, I pointed this out, and in the same year I suggested that the mathematicians' demand for rigor in their demonstrations will be satisfied if we assume, instead of infinitely small sizes, sizes as small as are needed to show that the error is less than that which any opponent can assign, and consequently that no error can be assigned at all.[284] So even if the exact infinitesimals which end the decreasing series of assigned sizes were like imaginary roots, this would not at all injure the infinitesimal calculus, or the calculus of differences and sums, which I have proposed and which excellent mathematicians have cultivated so fruitfully. Error is impossible in this calculus except through a failure to understand it, or a false application, because it contains its own demonstration. It was later acknowledged in the Journal de Trévoux, in the same place, that the objections which had been raised before do not apply to my explanation. It was still maintained, it is true, that these objections do apply to the calculus of the Marquis de l'Hospital, but I believe that he has no more desire than I to burden geometry with metaphysical problems.

I almost laughed at the airs which the Chevalier de Méré gave himself in the letter to Pascal which Mr. Bayle describes in the same article. But I can see that the chevalier knew that this great genius had his imperfections, which sometimes made him too susceptible to extreme spiritualistic impressions and even made him disgusted at intervals with sound knowledge. The same thing has since happened to Steno and Swammerdam, but without any restoration, because they failed to combine the true metaphysics with physics and mathematics.[285] De Méré took advantage of this fact to talk down to Pascal. It seems to me he was talking a little too frivolously, as is common with people of the world who have much spirit but mediocre knowledge. They try to convince us that what they do not fully understand is of slight importance; they should be sent to school with Mr. Roberval. Yet it is true that the chevalier had an unusual talent, especially for mathematics, and I have learned from Mr. des Billettes, a friend of Pascal's who excels in mechanics, what the discovery was of which the chevalier boasts in his letter. Being a great gambler, he made the first ventures into the calculation of wagers, and it was this that led to the beautiful studies of the game of hazard [de alea] by Fermat, Pascal, and Huygens which Roberval could not or would not understand.[286] The Pensionaire de Witt has pushed this study still further and applied it to other more important uses related to life insurance. Mr. Huygens told me that Mr. Hudde also had excellent ideas on the problem and that it is unfortunate that he suppressed these along with so many others. Games themselves deserve study, and, if a penetrating mathematician were to investigate them, he would find many important truths, for men never show more spirit than when they are jesting.

Let me add in passing that not only Cavalieri and Torricelli, of whom Gassendi spoke in the passage cited by Mr. Bayle, but also myself and many others have found figures of infinite length whose areas are finite. There is nothing more extraordinary about this than about infinite series, where we find that $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\frac{1}{32}+$ etc. $=1$. It may be, however, that the chevalier also experienced some fine enthusiasm which transported him "into that invisible world and into that infinite extension" of which he speaks and which I believe to be that of the ideas or forms of which certain Scholastics also speak in raising the question of whether "there is a vacuum of forms." For he says that "one can here discover the principles of things, the most hidden truths, the harmonies, the justice, the propositions, the true originals and perfect ideas of everything that one seeks."

This intelligible world of which the ancients speak so much is in God and in some way also in us. But what the letter says against division to infinity makes it clear that its author was still too much of a stranger in this superior world and that the charms of the visible world of which he wrote did not leave him the time which he needed to acquire the rights of citizenship in the other. Mr. Bayle is right in saying, with the ancients, that God uses geometry and that mathematics makes up a part of the intelligible world and is therefore the more fit to be an entrance into it. But I myself believe that its interior is something more. I have suggested elsewhere that there is a calculus more important than those of arithmetic and geometry which depends on the analysis of ideas. This would be a universal characteristic, and its formation seems to me one of the most important things that can be undertaken.

61

CONSIDERATIONS ON VITAL PRINCIPLES AND PLASTIC NATURES, BY THE AUTHOR OF THE SYSTEM OF PRE-ESTABLISHED HARMONY

1705

This paper was published in the Histoire des ouvrages des savants in May, 1705, in the form of a letter to Basnage de Beauval, its editor. Leibniz had been asked by Jean le Clerc, editor of the Bibliothèque choisie, to give his opinion, based upon the theory of pre-established harmony, about the controversy between Bayle and Le Clerc over the existence of vital principles and plastic natures, such as Cudworth and others had proposed.[287]

* * *

[G., VI, 539-46]

Since the dispute which has arisen concerning plastic natures and the principles of life has given an occasion for well-known persons interested in it to speak of my system, and it seems that some clarification of it is desired (cf. Bibliothèque choisie, Vol. V, Art. 5, p. 301, and also Histoire des ouvrages des savants, 1704, Art. 7, p. 393), I consider it fitting to add something to what I have already published on this subject in various articles in the journals cited by Mr. Bayle in his Dictionary, the article on Rorarius. I do indeed hold that vital principles are spread throughout all nature and are immortal, since they are indivisible substances or unities, while bodies are multitudes subject to destruction through the dissolution of their parts. These vital principles or souls have perception and appetite. When I am asked if they are substantial forms, I reply with a distinction. For if this term is taken to mean what Descartes meant in maintaining against Regis that the rational soul is the substantial form of man, I agree.[288] But I say "No" to anyone who takes the term in the sense of those who imagine that there is a substantial form in a piece of stone or in any other inorganic body. For vital principles belong only to organic bodies. It is true according to my system that there is no part whatever of matter which does not contain an infinity of organic and animated bodies, among which I include not only animals and plants but perhaps also other kinds which are entirely unknown to us. But one cannot say that every portion of matter is therefore animated, any more than we should say that a pond full of fish is an animated body, although the fish are.

My opinion on vital principles, however, is in certain respects different from what has previously been taught. One of these respects is that it has always been thought that vital principles change the course of motion in bodies, or at least that they provide God with the occasion for changing it. My system, instead, holds that this course is not at all changed within the order of nature, God having pre-established it as it should be. The Peripatetics believed that souls have an influence on bodies and that, according to their will or appetite, they give certain impressions to the body. The celebrated authors who by their vital principles and plastic natures have occasioned the present controversy have been of the same opinion, although they are not Peripatetics.[289] One can say the same thing about those who have made use of an archeus or a hylarchic principle, or other immaterial principles with other names.[290] Descartes very well recognized that there is a law of nature by which the same quantity of force is conserved, though he made a mistake in applying this principle by confusing quantity of force with quality of motion; he therefore thought it unnecessary to give the soul the power of increasing or diminishing the force of the body but only that of changing its direction by changing the course of the animal spirits. And those Cartesians who have given vogue to the doctrine of occasional causes hold that, since the soul can have no influence whatever upon the body, it is necessary for God to change the course and direction of the animal spirits in accordance with the wishes of the soul. But if this new law of nature which I have demonstrated had been known in Descartes's day, according to which not only the same quantity of total force of bodies in interrelation is conserved but also their total direction, he would undoubtedly have been led to my system of pre-established harmony, for he would have recognized that it is just as reasonable to say that the soul does not change the quantity of the direction of the body as it is to deny to the soul the power of changing the quantity of its force, both being equally contrary to the order of things and the laws of nature, since both are equally inexplicable. Therefore souls or vital principles, according to my system, change nothing in the ordinary course of bodies and do not even give God the occasion for doing so. The souls follow their laws, which consist in a definite development of perceptions according to goods and evils, and the bodies follow theirs, which consist in the laws of motion; nevertheless, these two beings of entirely different kind meet together and correspond to each other like two clocks perfectly regulated to the same time. It is this that I call the theory of pre-established harmony, which excludes every concept of miracle from purely natural actions and makes things run their course regulated in an intelligible manner. Instead of this, the common system has recourse to absolutely inexplainable influences, while in the system of occasional causes God is compelled at every moment, by a kind of general law and as if by compact, to change the natural course of the thoughts of the soul to adapt them to the impressions of the body and to interfere with the natural course of bodily movements in accordance with the volitions of the soul. This can only be explained by a perpetual miracle, whereas I explain the whole intelligently by the natures which God has established in things.

This system of pre-established harmony furnishes a new proof, hitherto unknown, of the existence of God, since it is very clear that the agreement of so many substances, none of which exerts an influence upon another, can only come from a general cause upon which all of them depend and that this cause must have infinite power and wisdom to pre-establish all these agreements. Even Mr. Bayle has expressed his judgment that no other hypothesis has ever given so much help to our knowledge of the divine wisdom.

This system also has the advantage of conserving, in its full rigor and generality, the great principle of physics that a body never receives a change in motion except through another body in motion which pushes it: *corpus non moveri nisi impulsum a corpore contiguo et moto.* This law has until now been violated by all those who accept souls or other immaterial principles, including here even all of the Cartesians. The Democriteans, Hobbes, and certain other outright materialists who have rejected every immaterial substance have heretofore been alone in preserving this law and think they have found a ground for abusing other philosophers, whom they believe to hold an unreasonable opinion in this. But the ground of their triumph is only apparent and *ad hominem*; far from serving their own view, this law serves to embarrass them. Now that their error is discovered and their assumed advantage turned against them, it can be said, it seems, that for the first time the preferable philosophy is also shown to be the more consistent with reason and that there is nothing left with which to oppose it. Though this general principle excludes particular prime movers, since it denies this quality to souls or created immaterial principles, it leaves us all the more certain and clear about the universal prime mover from whom come alike both the sequence and the correspondence of perceptions. These are like two kingdoms, one of efficient causes, the other of final, each of which separately suffices in detail to give a reason for the whole, as if the other did not exist. But neither is adequate without the other when we consider their origin, for they emanate from one source in which the power which makes efficient causes, and the wisdom which rules final causes, are found united. Even this maxim, that there is no motion which does not originate in another motion in accordance with mechanical rules, leads us again to a prime mover, because matter, being in itself indifferent to motion or repose but nevertheless always possessing motion with its whole force and direction, cannot have been put in motion except through the author of matter himself.

There is still another difference between the opinions of the other authors who favor vital principles and mine. This is that I believe that these vital principles are immortal and yet that they are everywhere. The common opinion holds instead that the souls of beasts perish, and, according to the Cartesians, it is only man who truly has a soul and, indeed, who has perception and appetite—an opinion which will never receive general approval and into which they rushed only because it seemed necessary either to ascribe immortal souls to beasts or to admit that the soul of man could be mortal. But we must rather say that, since all simple substance is imperishable, and consequently every soul immortal, the soul which one cannot reasonably deny to beasts must also subsist always, although in a way far different from ours, since the beasts, at least so far as we can judge, lack that reflection by which we think of ourselves. It is hard to see why men have found it so repugnant to ascribe imperishable and immortal substances to the bodies of other organic creatures, especially since the defenders of atoms have introduced material substances which do not perish, and since the soul of a beast has no more reflection than an atom. For there is a great difference between the sensation common to all these souls and the reflection which accompanies reason, since we may have a thousand sensations without reflecting about them. I do not find that the Cartesians have ever proved, or can prove, that all perception is accompanied by consciousness. It is just as reasonable that there should be substances capable of perception below us as above us, so that our soul, far from being the lowest of all, finds itself in the middle, from which one may rise or sink. Otherwise there would be a deficiency in order, or what some philosophers call a vacuum of forms. Thus both reason and nature lead men to the opinion which I have proposed but their prejudices have turned them away from it.

This opinion leads us to another in which I am also forced to abandon the accepted view. Those who agree with me will be asked what becomes of the souls of beasts after the animals die, and we shall have imputed to us the doctrine of Pythagoras, who believed in the transmigration of souls, a theory which not only the late Van Helmont (the son) but also the clever author of certain Metaphysical Meditations, published in Paris, have sought to revive.[291] But it must be seen that my opinion is far different from this, because I believe that not merely the soul but the whole animal subsists. Very exact observers have noted before now that it is doubtful that an entirely new animal is ever produced but that living animals as well as plants already exist in miniature in the seeds before conception. Assuming this doctrine to be true, we may reasonably conclude that what does not begin to live does not stop living either and that death, like generation, is only the transformation of the same animal, which is sometimes augmented and sometimes diminished. Thus we discover the marvels of divine artifice even where they have never been thought of. For since the mechanisms of nature are mechanisms down to their smallest parts, they are indestructible, since smaller machines are enfolded in greater machines into infinity. Thus one finds himself forced to maintain at the same time both the pre-existence of the soul with that of the animal and also the subsistence[292] of the animal with that of the soul.

I have come, imperceptibly, to an explanation of my opinion of the formation of plants and animals, since it appears from what I have said that they are never formed entirely anew. I am thus of the opinion of Mr. Cudworth, whose excellent work for the most part well supports me, that the laws of mechanism by themselves could not form an animal where there is nothing already organized.[293] I find that he is right in opposing what certain ancients have sensed on the subject, and also Descartes's *Traité de l'homme*, whose man costs so little to form but also so little resembles a true man. I strengthen this opinion of Cudworth's with the consideration that, if matter is arranged by divine wisdom, it must be essentially organized throughout and that there must thus be machines in the parts of the natural machine into infinity, so many enveloping structures and so many organic bodies enveloped, one within the other, that one can never produce any organic body entirely anew and without any preformation, nor any more destroy entirely an animal which already exists. So I have no need to resort, as does Cudworth, to certain immaterial *plastic natures*, though I recall that Julius Scaliger and other Peripatetics, as well as certain adherents of Van Helmont's doctrine of the archeus believed that the soul makes its own body. To this I can say *non mi bisogna, e non me basta,*[294] because this preformation and this infinitely complex organism provide me with material plastic natures that meet the need. Immaterial plastic natures, by contrast, are as unnecessary as they are incapable of satisfying it. For since animals are never formed naturally from an inorganic mass, the mechanism, though incapable of producing their infinitely varied organs anew, can at least draw them out of pre-existing organic bodies by a process of development and transformation. However, those who make use of plastic natures, whether material or immaterial, by no means weaken the proof for the existence of God drawn from the wonders of nature, which appear with particular force in the structure of animals, assuming that the defenders of immaterial plastic natures add to them a particular guidance by God, and assuming that those who make use, as I do, of a material cause, agree that the plastic mechanism supports not only a continual preformation but also an original divine pre-establishment. In whatever way one interprets this, therefore, one cannot escape the divine existence in seeking to explain these wonders which have always been admired, but which have never been shown so well as in my system.

This shows that not only the soul but also the animal must always subsist in the ordinary course of things. But the laws of nature are made and applied with so much order and wisdom that they serve more than one end. Thus God, who holds the place of inventor and architect in relation to the mechanism and the works of nature, holds the place of king and father to those substances which have intelligence and whose soul is a spirit formed in his image. With respect to spirits, his kingdom, of which they are citizens, is the most perfect monarchy which can be built. Here there is no sin without some punishment attached, no good action without some reward. Here all tends, finally, to the glory of the monarch and the happiness of the subjects, by the most beautiful combination of justice and goodness which could be wished. I do not venture an assertion with regard to pre-existence, however, or with regard to the details of the future state of human souls, since God is able to use extraordinary methods in these matters within the realm of grace. Nevertheless, the ways favored by the natural reason are to be preferred, at least so far as revelation does not teach the contrary. I do not undertake to decide this matter here.

Before closing, it may be well to point out, among the other advantages of my system, the universality of the rules which I use. These rules are always without exception in my general philosophy; in other systems the contrary is true. For example, I have here said that mechanical laws are never violated in natural motion, that the same force and the same direction are always conserved, that everything occurs in souls as if there were no bodies and everything in bodies as if there were no souls, that there is no part of space which is empty, that there is no part of matter which is not actually divided and does not contain organic bodies, that there are also souls everywhere as there are bodies everywhere, that the souls and even the animals subsist always, that organic bodies are never without souls, and that souls are never separated from organic bodies, though it may be true, nevertheless, that there is no part of matter of which one can say that it is always affected by the same soul. Thus I do not at all recognize entirely separated souls in the natural order or created spirits entirely detached from any body. In this I share the opinion of many ancient Church Fathers. God alone is above all matter, since he is its author. But creatures free or freed from matter would at the same time be divorced from the universal bond, like deserters from the general order. This universality in my rules is confirmed by a great facility in explanation, since the uniformity which I believe is observed in the whole of nature makes us say that everywhere, at every time, and in every place things are just as they are here, almost to the very degrees of grandeur and perfection, so that the most remote and most hidden things can be explained perfectly by analogy to what is visible and near unto us.

62

Letter to Hansch on the Platonic Philosophy or on Platonic Enthusiasm

July 25, 1707

Like Johann Christian Wolff, Michael Gottlieb Hansch (1683-1752) was one of the younger men who adopted Leibnizian ideas early in the new century and who entered into correspondence with their author. The following letter was published in his *Diatriba de enthusiasmo Platonico* in 1716; in 1728 he offered what Leibniz had frequently admitted he had himself not yet achieved—*Godofredi Guilielmi Leibnitii Principia philosophiae more geometrico demonstrata.*

* * *

[Dut., II, 222-25]

I have read your little work on Platonic enthusiasm with much pleasure, and I am convinced that what you are doing, along with others who are throwing light on the philosophies of the ancients, is most valuable. For such works both confirm and advance truths, whether merely revived or newly discovered. I should not care to quarrel with anyone as to whether Pythagoras and Plato learned anything from the Hebrews. So far I have not observed anything which would lead me to believe it. I recognize that the worship of one God, almost wiped out among mankind, was restored through the Hebrews. I am unwilling to believe that Homer and Hesiod visited the Egyptians. The author of Homer's life, who is held to be

Herodotus, says nothing of the kind about him. But I willingly admit that the Greeks owe the beginnings of the sciences to the Egyptians and Phoenicians. Abraham, who came from the Chaldeans, is rightly thought to have taught some things to the Egyptians. The very old doctrine of the immortality of souls seems to have had metempsychosis added to it by the Indians, and we may believe that it came from them to the Magi and the Egyptians. Pythagoras then introduced it into the West, and Plato generally followed him.

No ancient philosophy comes closer to Christianity, although we justly censure those who think that Plato is everywhere reconcilable with Christ. But the ancients must be excused for denying the beginning of things, or creation, and the resurrection of the body, for these doctrines can be known only by revelation.

Meanwhile many of the Platonic doctrines which you mention are most beautiful—that all things have a single cause; that there is an intelligible world in the divine mind, which I also usually call the region of ideas; and that the object of wisdom is the really real [τὰ ὄντως ὄντα] or simple substances, which I call monads and which, once existing, endure always; the first ground of life [πρῶτα δέκτικα τῆς ζώης],[295] that is, God and souls, and of the latter the most excellent ones, namely, minds, which are produced by God as images of divinity. The mathematical sciences, moreover, which deal with eternal truths rooted in the divine mind, prepare us for the knowledge of substances. Sensible things, however, and composite things in general, or the substantiated things, so to speak, are in flux and become rather than exist. Furthermore, as Plotinus has rightly said, every mind contains a kind of intelligible world within itself; indeed, in my opinion it also represents this sensible world to itself. But there is an infinite difference between our intellect and the divine, for God sees all things adequately and at once, while very few things are known distinctly by us; the rest lie hidden confusedly, as it were, in the chaos of our perceptions. Yet the seeds of the things we learn are within us—the ideas and the eternal truths which arise from them.

Since we discover *being, the one, substance, action*, and the like within ourselves, and since we are conscious of ourselves,[296] we need not wonder that their ideas are within us. The innate concepts of Plato, which he concealed by the term "reminiscence," are therefore by far to be preferred to the blank tablets of Aristotle, Locke, and other recent exoteric philosophers. So I believe that, to philosophize correctly, Plato must be combined usefully with Aristotle and Democritus, though a number of the principal doctrines would have to be stricken from each of them. The Platonists were not far wrong in recognizing four kinds of cognition in the mind—sense, opinion, knowledge (*scientia*), and understanding, or, in other words, experience, conjecture, demonstration, and pure intellection, which looks into the connections of truth by a single act of the mind; this belongs to God in all things but is given to us in simple matters only. But the more we grasp in a shorter time, the closer we approach in our demonstrations to this pure intellection. Although our mind depends continuously on God in its existence and action, as does every other creature, I do not think that it needs his particular concourse over and above the laws of nature for its perceptions, but rather that it deduces its later thoughts from its earlier ones by its internal force and in an order prescribed by God, as Roelius, whom you quote, rightly says. I extend this also to the perceptions of sensible things. For since they are not miraculously induced by God, and cannot be imparted naturally by the body, it follows that they arise within the soul by a definite law, as through a harmony divinely pre-established in the beginning. This is more worthy of the most wise Creator than the perpetual violation, by new impressions, of laws which he has given to the body or the soul. Meanwhile, it can be said that because of the divine concourse which continuously confers upon each creature whatever perfection there is in it, the external object of the soul is God alone and that in this sense God is to the mind what light is to the eye. This is that divine truth which shines forth in us, about which Augustine says so much and on which Malebranche follows him.

There is a sound sense in which we can understand that the soul is in this body as in a prison. But we must reject the opinion of the ancient philosophers that the body is a prison for punishing the understanding for its past sins. They were right in saying that the soul is attached to the body as to a post which it has no right to leave without the order of the supreme commander. It was a nice conception, too, that we are ruled by providence insofar as we follow reason; by fate and like a machine when we are carried away by our affections. For we have now seen, from the pre-established harmony, that God has ordered all things so wonderfully that corporeal machines serve minds and that what is providence in a mind is fate in a body.

The ancient Platonists and Stoics also had excellent views about the virtues, and Augustine is too severe with them. For not content with having sought perpetual sins in their virtues, which is itself too much, he also considered the precepts of the philosophers as entirely evil, as if they had measured everything bearing the name of virtue by the vanity of praise and by pride. But we know they often rightly commended the wise man, not out of hope of reward or fear of punishment, but out of love of virtue, and there is no difference between this love of virtue and that devotion to justice which Augustine teaches and which he refers to the essential justice, that is, to God himself, in whom is the source of the good and the true. Nor was Plato entirely ignorant of this, for he always looked to the truth in itself. But Augustine objects that philosophers have always measured things by themselves, and so have placed the creature above the creator.

I am afraid that this is oversubtle,[297] as is the opinion of certain people who have recently commanded us to love God without any consideration of ourselves. For it is impossible, by the nature of things, for anyone to have no thought for his own happiness. But for those who love God, their own happiness arises from that love. Even before the controversy had arisen about the distinction between mercenary and true love, I had seen this difficulty and resolved it in the Preface of my *Codex juris gentium*, 298 giving a definition of love which intelligent men have received with applause and which seems to decide the dispute. For, as opposed to mercenary love, true love is that affection of the mind by which we are brought to find pleasure in the happiness of another. For what we take pleasure in, that we desire for itself. Furthermore, since the divine happiness is the confluence of all perfections, and pleasure is the feeling of perfection, it follows that the true happiness of a created mind is in its sense of the divine happiness. So those who seek the right, the true, the good, and the just because this delights them rather than because it is profitable—although it is in truth most profitable—are best prepared for the love of God, according to the opinion of Augustine himself, who brilliantly shows that the good desire to enjoy God, the bad to use him, and who proves, as the Platonists tried to do, that the exchange of the divine love for the ephemeral is the cause of the fall of souls. Therefore, too, our happiness cannot be separated from the love of God.

Hence you may reject the quietists, false mystics, who deny individuality and action to the mind of the blessed, as if our highest perfection consisted in a kind of passive state, when, on the contrary, love and knowledge are operations of the mind and will. Blessedness of the soul does indeed consist in union with God, but we must not think that the soul is absorbed in God, having lost its individuality and activity, which alone constitute its distinct substance, for this would be an evil enthusiasm [ἐνθουσιασμος], an undesirable deification. Certain ancient and more recent thinkers have asserted, namely, that God is a spirit diffused throughout the whole universe, which animates organic bodies wherever it meets them, just as the wind produces music in organ pipes. The Stoics were probably not averse to this opinion, and the active intellect of the Averroists, and perhaps of Aristotle himself, reduce to it, being the same in all men. According to this view souls return to God in death, as streams to the ocean. I wish that Valentine Weigel, who, in an extraordinary book, not only explains the blessed life through deification, but frequently recommends a death and quiet of this sort, had not given us ground to suspect a similar opinion, along with other quietists. The chief to affirm this position is the man who calls himself John Angelus Silesius, the author of some beautiful sacred poems entitled *Der cherubinische Wandersmann.*[299] In another way Spinoza tends toward the same view. For him there is one substance, God. Creatures are his modifications, like figures in wax, continually arising and perishing through motion. So for him, just as for Almeric, the soul does not survive except through its ideal being in God, where it was from all eternity.

But I observe nothing in Plato that would lead me to conclude that minds do not conserve their own substance. This is beyond argument, moreover, for those who philosophize carefully, for the contrary opinion cannot be understood unless you assume that God and the soul are corporeal, for in no other way can souls be torn as parts away from God. But such a notion of God and the soul is absurd on other grounds. The mind is not a part but an image of divinity, a being which represents the universe, a citizen of the divine kingdom. And for God neither substance in general—simple substance, that is—nor person perishes in his kingdom. Souls which lack reason have substance incapable of happiness and misery. But I do not want to digress to them, since they are not pertinent to your discussion. In concluding this rather extended letter, I congratulate you on so well combining learning with wisdom and urge you to continue in this enlightened course.

63

Correspondence with Des Bosses

1709-15

The correspondence between Leibniz and Bartholomew des Bosses, Jesuit teacher of theology at the seminary of his order in Hildesheim, and after 1711 professor of mathematics at Cologne, contains Leibniz's last and most extensive attempt to put his philosophy in acceptable Scholastic terms. Though Guhrauer found in it "the most complete and coherent explanations of the monadology . . . preserved for us" (Guh. D., I, 373), most students have seen, in the central problem about which the later correspondence turned, an enigma which it is difficult to solve in terms of Leibniz's previous doctrine.

This problem is the nature of composite corporeal beings, particularly their substantiality and unity. In 1703 Tournemine had criticized Leibniz (see No. 54, X, and n. 231) for failing to explain the nature of the unity of soul and body but, like Descartes, merely establishing a simple correspondence between them. From its beginning the discussion with Des Bosses was concerned in general with the consistency of the monadology with Aristotle's metaphysics. In 1709 it turned to Tournemine's criticism when Des Bosses raised the question of the origin of the dominant entelechy and its relation to the body. Not only the Council of Trent's pronouncement on the Eucharist but also realistic demands for the substantial nature of compound bodies led now to the discussion of a substantial reifying chain which binds together the monads constituting such a body, its relation to these monads, its role in contributing to (a) the unified nature and (b) the continuous extension of such bodies, and the issue of whether it is a substantial form in the Scholastic sense.[300]

By 1712 Des Bosses and Leibniz agree upon the possibility of such a realitas unionalis, though the latter frequently emphasizes phenomenalism as an alternative. If composite bodies must be substantial, he insists that they are not original but secondary (or ortive) substances and that their reifying principle cannot itself be a mode or modification but must be a substantial form which is the source of modifications in the resulting bodily substance. Des Bosses argues, on the other hand, that the reifying chain cannot be considered as something absolute but must be a "nonmodal" or "categorial" accident, concepts which Leibniz is easily able to show contradictory in terms.

The total effect of the correspondence was a greater realistic emphasis in Leibniz's thought about the apparent physical world, evidences of which will be found also in Nos. 65 and 66.

The correspondence, which began after a visit by Des Bosses in 1706, covered a wide variety of topics from theology to Sinology and from problems of publication to ecclesiastical gossip. The selections given are largely restricted to the later philosophical argument.

* * *

I

Leibniz to Des Bosses[301]

[G., II, 369-72]

Hanover, April 30, 1709[302]

Two things usually make publishers hesitate—one is their desire to profit; the other is ignorance. Thus they do not know what they should select. They do not trust scholars enough, because they believe that scholars have a better understanding of what is scholarly than of what will sell. I tried recently to publish a dissertation which I wrote some time ago and in which I examined some problems of the ninth century and became involved in chronological studies. I called it *Flowers Scattered on the Grave of the Popess Joan*; in it I explode the fable of the popess, partly by new arguments, and partly by ~~con~~firming the old. I set the generally obscure chronology of the time in clear order, replying to the newest subterfuges of Frederick Spanheim, a Leyden theologian, which he put in a book published some years ago in Holland. I have also dealt with some matters that have been overlooked, for I discovered a book on magic ascribed to the popess which has not yet been published, and I drew some other things worthy of readers' interest from manuscripts. Perhaps this little book would please your printer in Liége better, but I would willingly give him either one—that in Latin about the popess as well as that in French against Bayle.[303]

Now I come to your philosophical question. I do not determine whether the souls of beasts were not created until the fourth day; in any case innumerable entelechies must have been created at once, at the very beginning. I merely wanted to explain how new souls could exist even if no new part of matter were created. And, if I am not mistaken, my recent letter showed this. By "matter" I here mean mass or secondary matter, where there is extension with resistance. I do not recall having assigned matter proper (taken in this sense) to any soul; on the contrary, every part of an organic body contains other entelechies. It is true, of course, that a soul cannot pass over from one organic body into another but remains always in the same organic body, not even death violating this law. But it must be remembered that even this organic body remains the same in the way in which the ship of Theseus or a river does; that is, it is in perpetual flux. And perhaps no portion of matter can be designated which always remains the property of the same animal or soul. If you consider the question more carefully, perhaps you will try to say that a certain point can at least be assigned to the soul. But a point is not a definite part of matter, and even an infinity of points gathered into one will not make extension. This I prove as follows.

Take a triangle ABC, with its side AC bisected at D, AD bisected at E, AE at F, AF at G, etc. (Fig. 37). Assuming that this has been done to infinity, we will have an infinite number of triangles, BCD, BDE, BEF, BFG, etc. Any one of these can exist separately (if we assign thickness to them so that they become bodies, or if we assume the triangle to have thickness from the beginning, that is, to be a pyramid). Thus each one has its own vertex. Now assume all these triangles put together so that they make the whole pyramid or triangle ABC; clearly all these infinite vertices compounded together in this way make up only the one common vertex B. If you do not wish to introduce an infinity of triangles, you will at least see that this is generally true of any number of triangles. Extension arises from situation, but it adds continuity to situation. Points have situation, but they neither have nor compose continuity, nor can they stand by themselves. So there is nothing to prevent an infinity of points from coming into being and perishing (or at least coinciding or standing mutually outside of each other), without any increase or diminution of matter and extension, since they are only the modifications of matter and not its parts but its extremities. I do not consider it fitting, however, to think of souls as if they were in points. Perhaps someone would say that souls are not in a place except through an operation, speaking, that is, according to the old system of influence; or, better, speaking according to the new system of pre-established harmony, that they are in a place only through correspondence and that they

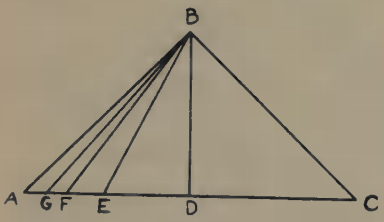

Fig. 37

are thus in the whole organic body which they animate. However, I do not deny some real metaphysical union between the soul and the organic body, according to which it can be said that the soul is truly in the body; I have also said this in reply to Tournemine. But because such a thing cannot be explained by the phenomena and changes nothing in them, I cannot explain any more distinctly of what this union formally consists. It is enough that it is tied up with the correspondence. You will understand, moreover, that I have been speaking so far, not of the union of the entelechy or active principle with primary matter or passive power, but of the union of the soul or of the monad itself (which is the result of both of these principles) with the mass or with other monads.

But what, you may ask, shall we say of this primary matter itself, which belongs to the soul? I reply that it is certainly created together with the soul or that the whole monad is created. Then does not primary matter increase and decrease? I acknowledge that it does, since it is only primitive passive power. Then mass also increases, you say. I agree that the number of monads increases, the result of which is the mass, but not the extension and resistance, nor the phenomena, any more than when new points arise. God could create an infinity of new monads without increasing the mass, if he merely added old monads to the organic body of the new monad. Mass is a real phenomenon, but, with the exception of those which appear anew with the new monad itself, phenomena are not at all changed through the creation of a new monad, except perhaps by a miracle. For we must hold that the old monads have been so ordered from the beginning by God when he created them that their phenomena would correspond to the monad to be created sometime later, unless we prefer the view that God changes all other monads by a miracle when he creates a new one to adapt them to the new one; this is less likely.

In conclusion, all this tends to show that it is possible for God to create new monads. Yet I do not assert definitely that new monads are created by God. On the contrary, I think the view that the opposite is more probable can be defended and that monads preexist. In place of the absolute creation of a rational soul, the transcreation of a nonrational into a rational soul could be defended; this would happen if an essential degree of perfection were miraculously added to it. I maintain this view also in my dissertation against Bayle, as it seems to me more probable than complete creation and more true than traduction. . . .

P. S.[304] Many years ago, when my philosophy was still too immature, I located souls in points and thus thought that the multiplication of souls could be explained through traduction, since many points can be made out of a single point, as the vertices of many triangles can be made through division from the vertex of one.[305] But having grown more circumspect, I grasped that we were not only led into innumerable difficulties in this way but also that this contains a certain confusion of classes, so to speak. Properties pertaining to extension are not to be assigned to souls, and their unity and multitude are not to be derived from the category of quantity but from the category of substance, that is, not from points but from the primitive force of action. But the action proper to the soul is perception, and the nexus of perceptions, according to which subsequent ones are derived from preceding ones, makes up the unity of the percipient.

II

Leibniz to Des Bosses

[G., II, 409]

Hanover, August 4, 1710

. . . In my earlier letter I had not noticed the objection which your last letter contained against the pre-established harmony; otherwise I should have answered at once, since it is one of those criticisms which I find most pleasing because they give opportunity to illumine the matter more fully. The very fact, namely, that the world, matter, and mind cannot be understood perfectly by finite minds is the argument which I use, among others, to prove that matter is not composed of atoms but is actually subdivided into infinity, so that there is in any particle of matter whatever a world of creatures infinite in number. If, on the contrary, the world were an aggregate of atoms, it could be known completely by a finite mind of sufficient excellence. Moreover, since no part of matter can be known perfectly by a created being, it appears from this that no soul can be known perfectly by a creature either, since the soul represents matter exactly through this very pre-established harmony. What you see as an objection can therefore be viewed as an argument for my position. . . .

III

Leibniz to Des Bosses

[G., II, 412]

Hanover, November 7, 1710

. . . I am pleased that my reply to your objection has satisfied you and especially that it was not entirely unforeseen. Whoever admits the pre-established harmony cannot fail also to accept the doctrine of the actual division of matter into infinite parts. But the same conclusion follows from elsewhere, namely, from the nature of the motion of fluids and from the fact that all bodies have a degree of fluidity.

Would that the attribute of incomprehensibility did belong to God alone; our hope of knowing nature would then be greater. But it is all too true that there is no part of nature which we can understand perfectly; the very interdependence [περιχώρησις] of things proves this. No creature, however excellent, can at once distinctly perceive or comprehend the infinite; on the contrary, indeed, whoever were to understand a single part of matter would understand the whole universe, by virtue of this same περιχώρησιν of which I spoke. My principles are such that they can hardly be torn apart from each other. He who knows one well, knows them all. . . .

IV

Leibniz to Des Bosses[306]

[G., II, 435-37]

Hanover, February 5, 1712

If a corporeal substance is something real in addition to monads, as a line is known to be something more than points, it will have to be said that corporeal substance consists in a kind of union or, rather, in a real unifier [*uniente reali*] superadded to the monads by God and that out of the union of the passive power of the monads there arises primary matter or the impulsion [*exigentia*] to extension and antitypy or to diffusion and resistance. From the union of the monadic entelechies, however, there arises a substantial form. But whatever can arise and be extinguished in this way is also destroyed by the cessation of the union, unless it is conserved miraculously by God. Such a form, moreover, will then not be a soul, which is a simple and indivisible substance. This form, too, is in perpetual flux, just as is matter, since no point can truly be designated in matter which preserves the same position beyond a moment and which does not recede from its neighbors, however many they may be. But the soul remains the same in all its changes, and the same subject persists; in corporeal substance this is not so. We must therefore say one of two things: either bodies are mere phenomena, in which case extension too will be only a phenomenon and only monads will be real, but the union will be supplied in the phenomenon by the action of the perceiving soul; or, if faith urges us to assert corporeal substances,[307] substance consists in that unifying reality [*realitate unionali*] which adds *something absolute* and hence substantial, even though fluid, to the things to be united. It is in the change of this being that your transubstantiation would have to be located, for monads are not truly ingredients of this added being but requisites, even if they may be needed for it, not by an absolute metaphysical necessity, but by exigency only. Thus the substance of a body may change, but the monads be saved, and sensible phenomena based upon them. A nonmodal accident seems to be hard to explain, and I do not hold extension to be one. It can be said that, even though monads are not accidents, it nevertheless happens [*accidere*] to a unifying substance that it may have them, by physical necessity, just as it happens to a body that it may be struck by another body, even though a body is not an accident. The extension of a body seems to be nothing but the continuation of matter through parts external to each other, or diffusion. But where this "externality" ends supernaturally, the extension which happens to the body itself also ends, and extension will remain only phenomenal, based in the monads along with the other properties which arise from them and which alone would exist if there were no unifying substance. If this substantial chain of monads [*monadum substantiale vinculum*] were absent, all bodies along with all their qualities would be nothing but well-founded phenomena, like the rainbow or an image in a mirror—in a word, continued dreams in perfect agreement with each other—and the reality of these phenomena would consist in this one fact. For we cannot say that monads are parts of bodies which touch each other, any more than we can say this of points or of souls. A monad, like the soul, is as a world by itself, having no intercourse of a dependent nature except with God. Therefore, if a body is a substance, it is the actualization [*realisatio*][308] of phenomena proceeding beyond their mere congruence.

But if you do not want to consider these occurrences in the

Eucharist to be merely phenomenal, they can be said to be grounded in a certain primary occurrence—not in extension, which cannot be permanent, but in the points of this extension which correspond to monads, the union which constitutes the continuum out of these points being removed, and thus lines and continuous figures being dropped, but qualities and other real accidents retained by means of the accidental points which remain, but with the continuity removed which depended upon the unifying reality of the substantial chain. When the diffusion of this chain through parts external to each other ceased, it too would cease. These accidental points could thus be considered as primary accidents, and this would be the basis for the rest, and in a sense which is nonmodal, which cannot be said of extension or of the continuous diffusion of matter.

In fact, when I weigh the matter more carefully, I see that extension can itself be saved and that your opinion explaining the position of your society can thus be granted, even if one is opposed to phenomena. For since accidental points can be admitted, we could—indeed, we should perhaps—also admit their union. Then we have an absolute accidental extension. But such extension would formally involve a diffusion of parts beyond parts, though that which is diffused will not be matter or corporeal substance formally but only exigently [*exigentialiter*]. That which is diffused formally will be locality or that which constitutes *situs*; it will be necessary to conceive this itself as something absolute. So I believe that we will not quarrel, now, provided that the monads are not involved in this supernatural change of the substance of a body, which would be entirely unnecessary, since, as I said, they are not parts of it—especially since the soul of Christ does not, according to your own views, change in transubstantiation, nor does it take a position in the substance[309] of the bread. I should say the same also of the monads of the most holy body. To speak candidly, however, I should prefer to explain the accidents of the Eucharist through phenomena; then we shall not need nonmodal accidents, for which I care very little. . . .

. . . Unless you decide otherwise, I think the title *Tentamina* theodicaeae can be kept. For theodicy is, as it were, a kind of science, namely, the doctrine of the justice of God—that is, of his wisdom together with his goodness.[310] . . .

V

Des Bosses to Leibniz

[G., II, 441-42]

Paderborn, May 20, 1712

I finally reply to your letter sent to me in February, which was the more welcome for its greater length. I begin with the question about bodies, which I read through in your letter with the greatest satisfaction, and I have thought about it no less attentively. You say that we must say one thing or another: either bodies are mere phenomena, and then extension will be only a phenomenon; or there is superadded to the monads a certain unifying reality which is something absolute (and therefore substantial) even though it adds a unifying fluidity to the (monads). This disjunction I accept with respect to the matter itself, but I now argue that the former is not true and therefore that the latter is.

If bodies were mere phenomena, indeed, the paradox of Zeno would be true, who denies all true, proper motion, for, if there are no things to touch each other, nothing will be moved. To deny this member of the disjunction the principles of all the philosophers seem to suffice, joined with the naïve prejudice, both of which show no doubt that there is in any body something more than phenomena, that is, something more than continuous dreams, no matter how perfectly these may fit each other. . . .

So it remains for us to accept something absolute in which the reification of phenomena consists. This you call a substance, I an accident; but I believe we are not in disagreement about the matter itself. I call an accident whatever in itself presupposes a complete substance, so that it cannot naturally exist without this substance. And this absolute unifier presupposes complete substance or the monads, without which it cannot exist naturally. For, according to you, "monads are in fact ingredients of this added being, and yet not requisite to it in the sense of an absolute and metaphysical necessity but only exigently." This I interpret as meaning that monads are required by this added being as something prior in nature to it. If you do not reject this interpretation (and it does not seem that you can reject it, for whatever does not contain a principle of unity within itself must presuppose one from elsewhere), it is now obvious that this added thing is not a substance in the sense of the Peripatetics, who understand by substance nothing but a primary being, a substratum and presupposition for the rest. Therefore we will now have in bodies something absolute, distinct from the monads, which is not a substance; and so, since the body adds nothing to the monads except this absolute being, only an accident is superadded to them.

Furthermore, I should not wish to ground this absolute solely in the accidental points corresponding to the monads, for the same difficulty seems to remain about these points as about the monads themselves. By what compact, namely, can they make an extended being when they are not themselves extended? So it seems further necessary to resort to something unifying which can be called absolute accidental extension. For the rest, I admit that, if the natural organization of bodies could be explained by phenomena alone, there would be no philosophical ground for resorting to nonmodal accidents in explaining the accidents of the Eucharist. But, as I have said above, the common sense of men seems to understand that there is something more in sensible bodies than phenomena consisting in the operation of the perceiving mind. And, speaking only of natural events, there ought to correspond to this perception some object distinct from the perception itself; otherwise there would be no harmony. . . .

VI

Leibniz to Des Bosses

[G., II, 444]

Hanover, May 26, 1712

If you deny that what is superadded to the monads to make a union is of the nature of a substance, you cannot say that a body is a substance, for it will then be a mere aggregate of monads; and I fear that you will fall back upon the mere phenomenality of body. For in themselves monads have no situation [situs] with respect to each other, that is, no real order which reaches beyond the order of phenomena. Each is as it were a separate world, and they correspond to each other through their own phenomena and not by any other intercourse and connection.

If you call an accident whatever presupposes a complete substance in such a way that it cannot naturally be without it, you do not explain the essential mark of an accident by which it must be distinguished from substance itself, even in a supernatural state. The Peripatetics as a whole recognize something substantial besides monads; otherwise they would have no substances besides monads. Monads do not constitute a complete composite substance, since they do not make up a unity per se but merely an aggregate, unless some substantial chain is added.

It cannot be proved from the principle of harmony that there is anything in bodies besides phenomena. For we know on other grounds that the harmony of phenomena in souls does not arise from the influence of bodies but is pre-established. This would suffice if there were only souls or monads; in this case all real extension would also disappear, not to speak of real motion, whose reality would be reduced to mere changes in phenomena.

I wish someone would present the entire system of Jansen in a compendium; without this it is difficult to judge his position correctly in a matter so involved.[311] It seems to be possible to carve contrary opinions out of Augustine by separating his words from their context; it is possible that the same thing has happened to Jansen. But the connection of his thoughts can remove this doubt. In reading Augustine, one must be very well at home in his works, and know the time, the scope, and the outline of his different books, if one does not want to be deceived by passages taken from them. I noticed this long ago after examining some of his passages more carefully, and I have become more cautious with him. . . .

VII

Des Bosses to Leibniz

[G., II, 446-47][395]

Paderborn, June 12, 1712

. . . I come now to the philosophical sections of your letter. You say, "If you deny that what is superadded to the monads in order to make a union is substantial, then a body cannot be called a substance, for it will then be a mere aggregate of monads." I reply that the Peripatetics establish a twofold meaning of body, one which is placed in the category of substance, and this is a substance in the way which I shall explain a little later; the other is mathematical, and this consists in the dimensional quantity which I acknowledge to be a mere accident. It was only with this meaning that I was dealing in my last letter. For I admit that the body, taken in the former meaning, would be a mere aggregate of monads if there were no substantial unity between the monads. This unity I further conceive of as follows, and I explain it in Peripatetic terms, by which I shall try to adapt your system in some way or other to the usage of the School.

Forms, and thus monads themselves (I except the rational soul), are always, with regard to their essence or with regard to metaphysical actuality, not with regard to existence or to physical actuality, almost of the nature by which, according to some Peripatetics, parts are said to be in the whole potentially, or as Averroes and Zarabella think that elements remain in mixtures, namely, "refracted." In an animal, for example, a horse, only the dominant form, namely, the soul of the horse, has existence or physical actuality. Since being and one are convertible, a thing is made one through the very thing by which it is made to exist, and so, since the whole animal has existence by virtue of an existent being which emanates from the soul, the body of the animal is constituted a unity through this existence. Furthermore, this existence is a kind of substantial mode emanating from the soul or the total and dominant form and affecting the other partial monads and subordinating them to itself, with the result that, from these subordinate monads and this dominant monad, there exists one corporeal substance which is called a horse.

It follows from this that the monads, viewed with respect to their essence and disregarding all existence or physical actuality, are indeed substances and primary complete beings in a metaphysical sense, because they have metaphysical actuality or an entelechy, yet they are not complete in the sense of physical substance, except insofar as and when a dominant entelechy bestows existence and therefore unity to the whole organic mass, for example, to the body of the horse, so that this itself will be subordinate to no other entelechy.[312] . . .

VIII

Leibniz to Des Bosses

[G., II, 450-52]

Hanover, June 16, 1712

. . . You . . . confer a benefit when you note the opinions of scholars from your holy order which agree with any whatsoever of mine. This is worth much, both in confirming and in understanding them. Of the Reverend Father Sebastian Izquierdo, I do not recall having seen anything but a book entitled Pharus scientiarum, which I saw as a youth but whose idea has almost escaped me. Certain phrases of Izquierdo in the passages which you have excerpted diverge somewhat from mine, but we seem to agree in the essence. For example, when he says that, in creating the world, God was necessitated morally but not physically, I should prefer to say morally, not metaphysically, for in my book I explain physical necessity as the consequence of moral.

I consider the explanation of all phenomena solely through the perceptions of monads functioning in harmony with each other, with corporeal substances rejected, to be useful for a fundamental investigation of things. In this way of explaining things, space is the order of coexisting phenomena, as time is the order of successive phenomena, and there is no spatial or absolute nearness or distance between monads. And to say that they are crowded together in a point or disseminated in space is to use certain fictions of our mind when we seek to visualize freely what can only be understood. In this conception, also, there is involved no extension or composition of the continuum, and all difficulties about points disappear. It is this that I tried to say somewhere in my Theodicy—that the difficulties in the composition of a continuum ought to warn us that we must think far differently of things.[313] We must see then what must be superadded to monads if we add a substantial union or assume that there is a corporeal, and therefore a material, substance; whether it be necessary in that case to return to a mathematical body. Certainly monads cannot properly be in an absolute space, since they are not really ingredients but merely requisites of matter. It will not be necessary on this ground, therefore, to set up certain indivisible localities, which throw us into such difficulties. It is enough that corporeal substance is something that reifies [realizans] phenomena outside of souls, but I should not wish to conceive actual parts in it except those made by actual division, nor indivisible parts, except as an extreme measure.

I believe that monads always have full existence and that we cannot conceive of parts being said to be potentially in the whole. Nor do I see what a dominant monad would detract from the existence of other monads, since there is really no intercourse between them but merely an agreement. The unity of corporeal substance in a horse does not arise from any "refraction" of monads but from a superadded substantial chain through which nothing else is changed in the monads themselves. Some worm can be a part of my body and subject to my dominant monad, and the same worm can have other animalcules in its body subject to its dominant monads. But, considered in the monads themselves, domination and subordination consist only in degrees of perfection.

If an *accident* is defined as that which strives [*exigo*] to exist in a substance, I fear that, in order to explain its formal reason, we must find a reason[314] why it strives. For certainly a substance also often demands [*exigo*] another substance; it would have to be explained what this "existing in" [*inesse*] is in which the nature of an accident is usually located. My own answer to this would be that it is the modification of something entirely other.

It is true that things which happen in the soul must agree with those which happen outside of it. But for this it is enough for the things taking place in one soul to correspond with each other as well as with those happening in any other soul, and it is not necessary to assume anything outside of all souls or monads. According to this hypothesis, we mean nothing else when we say that Socrates is sitting down than that what we understand by "Socrates" and by "sitting down" is appearing to us and to others who are concerned. . . .

IX

Leibniz to Des Bosses

[G., II, 457-61]

Wolfenbüttel, September 20, 1712[315]

. . . Your version is beautiful and will throw light on the work. But on my part I am taking advantage of the freedom you have allowed me, and while you have limited yourself more narrowly to the original and so interpret all the more faithfully, I am explaining some things more clearly than they are in the French. Occasionally I am formulating matters more fully, as I should have done if I had written in Latin. When I return to Hanover—for I am now at work in Wolfenbüttel—I shall send the work back to you.[316]

I come now to your philosophical points. If we accept substantial beings in addition to the monads, or admit some kind of real union, I feel that a union which makes an animal or any organic body of nature a substantial unity with one dominant monad is far different from a union which makes it a simple aggregate such as a pile of stones. The latter consists in a mere union of presence or of place, the former in a union constituting a new substantiation; the Scholastics call it a one per se, while they call the former a one *per accidens*. I nowhere said that monads otherwise unchanged would now constitute a horse and now not constitute one, for, since a monad always expresses within itself its relations to all others, it will perceive far different things when it is in a horse than in a dog. That it depends upon a substance does not suffice to define the nature of an accident, for a composite substance also depends on simple substances or monads; we must add that an accident depends on a substance as a subject and, indeed, as ultimate subject. For an accident can be the affection of another accident; for example, the magnitude of heat or of impetus, so that the impetus is the subject and the magnitude is in it as an abstraction from the predicate, when we say that the impetus is great or is so much. Yet heat or impetus is in the body as in a subject, and the ultimate subject is always the substance. Every accident is a kind of abstraction; only substance is concrete. Accidents can also have concrete predicates, as when an impetus is called great, but they themselves are not concrete but abstracted from the predicates of substances.

Furthermore, since the composite substance or the thing which makes the chain of monads is not a mere modification of the monads and does not exist in them as subjects—for, of course, the same modification cannot be in many subjects at the same time—I should hold that this substance depends on the monads, not in a logical dependence, that is, in such a way that it cannot be separated from them even supernaturally but merely in a natural dependence or in such a way that it strives to unite in a composite substance unless God wills otherwise. For God can use the same substance to unite other monads, so that it stops uniting the former ones; he can also remove it entirely and substitute for it another one, uniting other monads, and this either in such a way that it stops uniting the other monads and is transferred from one set of monads to another or in such a way that it retains its own monads, which it unites naturally, but now also unites new ones supernaturally. And, according to your views, it seems this is what must be said of the change of the whole substance of a corporeal body into the whole substance of another body which at the same time retains its former nature.

Let us come now to the real accidents which are in this unifying thing as their subject. You will agree, I believe, that some of them are only its modifications, which disappear when it is removed. But you ask whether there are not certain accidents which are more than modifications. Such accidents seem, however, to be entirely superfluous, and whatever is in such a substance other than a modification seems to pertain to the substantial thing itself. I do not see how we can distinguish an abstraction from the concrete, or from the subject in which it is; or how we can explain intelligibly what it is to be in or to inhere in a subject, except by considering inherence as a mode or state of a subject—a mode which may be either essential, so that it cannot change unless the nature of the substance changes, and differs from the substance only relatively, or which may be accidental, in which case it is called a modification and can come into being and perish while the subject remains. If you know another way of explaining inherence, I ask you to suggest it, for the issue hangs upon it. If this cannot be done, it must be feared that, by saying that real accidents are conserved, you are truly conserving the substance, and thus the whole substance will not be transmuted. Hence, if I remember rightly, the Greeks also deny that real accidents are conserved, for they fear that then both nature and substance will be conserved together.

You say that it seems there can be no middle being between a substance and a modification. I should think that this middle being is the substantiated unity per se, or the composite substance, for it is the mean between a simple substance—or that which primarily deserves the name substance—and the modification. The simple substance[317] is perpetual; the substantiated can come into being and perish or can change. An accident is that which arises and ceases, while the substance is changed but itself remains. Besides, an accident is incapable of a new modification per se, that is, it is capable of it only per accidens or insofar as it is in a substance modified through another which is also accidental. For example, the same impetus or heat that is in the body A is now present in body B, now absent from it, because of the presence or absence from it of body A. But the same impetus cannot be greater or less, for, while the former remains the same, a new degree is added as well, and the consequent total is different from the preceding total. Likewise, the same impetus cannot be sent first in this direction, then in that, for a new impetus added to the former will also have another direction and will thus determine a new total direction, both of the partial ones remaining. But the total impetus, itself composed of the others, will also provide a new total.

Granting these things, I should think that your theory of transubstantiation can be explained by retaining the monads, which seem to fit the reason and order of the universe perfectly, but with a substantial chain added by God to unite the body of Christ to the monads of bread and wine, and the former substantial chain destroyed, and its modifications and accidents with it. Thus there would remain only the phenomena of the monads of bread and wine, which would have been there if no substantial chain had been added by God to these monads. But even if the bread or the wine is not a substantiated being constituting a unity per se and hence is not unified by a substantial chain, it is still an aggregate of organic bodies or substances constituting a unity per se, whose substantial chains would be destroyed and replaced by the substantial chain of the body of Christ. . . .

. . . You ask why, if real extension is not necessary, primary matter is necessary and why the entelechy alone does not make up the monad. I reply that, if there are only monads with their perceptions, primary matter will be nothing but the passive power of the monads, and entelechy will be their active power. But when you add composite substances, I must say that there must be added to these a principle of resistance to the active principle or motive force. You ask further: Why actually an infinity of monads? I reply that the mere possibility of an infinity is enough to establish this, since it is manifest how very rich are the works of God. But the order of things also demands it, for otherwise phenomena would not correspond to all assignable percipients. Indeed, we know some confusedness in our perceptions, however distinct they may be, and so there are monads corresponding to these confused ones as there are monads corresponding to the greater and more distinct ones. Finally, you ask why fruit appears round rather than square if it is not really extended. I reply that fruit is itself only a phenomenon, since it is a being by aggregation.

X

Leibniz to Des Bosses

[G., II, 473-75]

Vienna, Austria, January 24, 1713

You ask how the opinion of your order about transubstantiation [περὶ τοῦ μετουσιασμοῦ] can be explained, both according to the hypothesis of mere monads and according to the hypothesis of compound substances. Following the former hypothesis, you ask in what the substance of a composite body consists, whether in monads or even in the phenomena themselves. That is, you ask, for example, whether the soul of a worm existing in the body of a man is a substantial part of the human body, or whether it is rather a bare requisite, and that not by metaphysical necessity but only because it is required in the course[318] of nature; this is the view which I should prefer. But if you assert the former, then we must say that the monads of bread and wine are destroyed and the monads of the body of Christ put in their place. If monads are not substantial parts of bodies, however, and composite beings are mere phenomena, it would have to be said that the substance of bodies consists in true phenomena—phenomena, namely, which God himself perceives in them through intuition [*scientia visionis*], as do also angels and the blessed, to whom it is given to see things truly. So God and the blessed would perceive the body of Christ where only bread and wine appear to us.

But if we should follow the popular hypothesis about corporeal or composite substances, I should say, as I have already expressed my opinion in my preceding letter, that a substantial chain or a substantial addition to the monads, which formally constitutes the compound substance and reifies the phenomena, can be changed while the monads themselves remain, because, as I have said, the soul of the little worm is not of the substance of the body which contains the worm, and we ought not to multiply miracles beyond necessity. A substantial chain superadded to the monads is in my opinion something absolute, such that, although it corresponds accurately, in the course of nature, to the affections of the monads, that is, to their perceptions and appetites, and can therefore be taken to be within the monad in whose body its body is, it can nevertheless be independent of the monads in a supernatural sense and can be removed and adapted to other monads while its former monads remain. Thus the monads of bread and wine would then be without any substantial chain, the matter being reduced, as far as they are concerned, to the state of the hypothesis of mere monads. The accidents of bread and wine, or the phenomena, would remain, moreover, but not in the body of Christ as subject. . . . In your fifth point and elsewhere in your letter[31[illegible]] you seem to have taken substantial chains in a different sense than I have, as if I think of them as having existed from the beginning of creation when I treat them as absolute entities. But if corporeal substances or substantial chains are admitted, my opinion must be taken to be that they are subject to generation and corruption. I have also adopted no new modification of monads, whether substantial or accidental, which will constitute composite substance, as you seem to interpret me in your Item 6, and I recognize nothing in the monads except perceptions and appetitions. I should be unwilling to call the chain which makes up a compound substance an absolute accident, because I hold every absolute to be substantial. If you wish to make it an accident, however, we shall be quarreling over a name, although there will be some incongruity in saying that a compound substance is constituted through accidents. When Smiglecius follows Aristotle in saying that no accident is without a subject, he shows that he does not admit an absolute being. I should also prefer not to distinguish, as you seem to do in Item 7, between a being that reifies phenomena and a substantial chain. These two things are truly the same for me, and we must say that they come into being and perish. If compound substances are assumed, therefore, it seems to me incomparably easier and more convenient to destroy the being which actualizes phenomena, while saving the monads, than to do the contrary, as you seem to prefer in Item 8.

The modifications of one monad are the ideal causes of the modifications of other monads (with this you deal in Item 17), insofar as there appear in one monad reasons which moved God from the beginning of things to establish modifications in another monad.

In the hypothesis of mere monads, the infinitude of the physical continuum would depend not so much on the principle of the best as on the principle of sufficient reason, because there is no reason for limiting or ending, or stopping anywhere. The mathematical continuum consists in mere possibility, as do numbers; hence infinity is necessarily implied in its very concept.

For the rest, you will be surprised to see these letters from Vienna, Austria. I decided to continue my journey here after I recently answered a summons to Karlsbad from the great monarch of Russia, for I had already finished half of the journey. I shall remain here until the season becomes moderate; then I hope by the goodness of God to return home.[320]

XI

Leibniz to Des Bosses

[G., II, 485-86]

Vienna, April 21, 1714

. . . It is worth inquiring into what can be contrived that will be appropriate to justify the reality of a phenomenon outside of the percipient being, or what constitutes a composite substance. So far as I can judge, it will have to consist of the primitive active and passive power of the composite being, and this will be what is called primary matter and substantial form. And it will be necessary for the accidents of the composite being to be its modifications;

these will be transitory, but it itself will remain a composite substance, as much as will the dominant monad. But it will not be a composite substance, or a true being constituting a unity per se, unless there is a dominant monad with a living organic body.

What you say about this substantial chain supervening upon a composite being already constituted through modal chains, I interpret in the sense that, cut away from the composite substance, the monads constitute a unity only *per accidens*; but, if I am not mistaken, this unity *per accidens* will be a mere phenomenon. For since no modification can subsist by itself but essentially entails a substantia subject, these chains will have what reality they possess in the modification of each monad and in the harmony or agreement of the monads with each other. I do not believe that you will admit an accident that is in two subjects at the same time. My judgment about relations is that paternity in David is one thing, sonship in Solomon another, but that the relation common to both is a merely mental thing whose basis is the modifications of the individuals. . . .

XII

Leibniz to Des Bosses

[G., II, 492]

Hanover, March 15, 1715

This winter I have experienced a rather severe case of gout, from which I have not yet fully recovered, and so I have painfully carried out only necessary labors which permitted no delay. But, since there always remains a hope at bottom, I do not despair of recovering my health.

I fear that the man who wrote in favor of physical predetermination in the action of God on creatures will complicate notions rather than bring light to them.[321] That acts are not absolute things but modifications of an entelechy or primitive conatus, I believe to be obvious, and this must be said not only of the will but also of every faculty of action. We rightly regard bodies as things, for phenomena too are real. But anyone who tries to consider bodies as substances will, I believe, need some new principle of real union.

The Irishman who attacks the reality of bodies seems neither to offer suitable reasons nor to explain his position sufficiently. I suspect that he belongs to the class of men who want to be known for their paradoxes.[322] . . .

XIII

Des Bosses to Leibniz

[G., II, 493]

Cologne, April 6, 1715

. . . You seem not to have noticed a small objection made in one of my earlier letters, the answer to which I should like from you. It is this. In the hypothesis that there is something reifying phenomena which is distinct from the monads and their perceptions, I asked what brings about the change of the phenomena within the body itself. If God, this will be a perpetual miracle; if the monads, then the body will in some way depend upon monads, etc.

I add another objection about the pre-established harmony. If the monads of the universe get their perceptions out of their own store, so to speak, and without any physical influence of one upon the other; if, furthermore, the perceptions of each monad correspond exactly to the rest of the monads which God has already created, and to the perceptions of these monads, and are harmonized so as to represent them; it follows that God could not create any one of these monads which thus exist without constructing all the others which equally exist now, for God can by no means bring it about that the natural perception and representation of the monads should be in error; their perception would be in error, however, if it were applied to nonexistent monads as if they existed. But if it is true that God could not do this, I do not see why we should so greatly praise the divine wisdom in the selection and organization of things with each other. For once any monad whatever, even the smallest which he produced, was chosen, God was necessitated to produce all the rest, just as he was necessitated not to deceive rational creatures or not to put error into them, or just as he was necessitated to attune the outcome to his promises. . . .

XIV

Leibniz to Des Bosses

[G., II, 495-96]

Hanover, April 29, 1715

. . . Your objections are usually shrewd, and I am always grateful for them. Assuming that there is a real union, reifying or, better, substantializing phenomena, you ask what brings about changes in the body itself. I reply that since the body, if it is held to be a substance, can only be that which results from the real union of monads, there will result from the union also the modifications which it will have, corresponding to the changes in the monads; and to this extent they will take place as is popularly taught. The monads influence this reifier, but it itself will change nothing in their laws, for whatever modifications it will receive from them it will have as an echo, as it were, but naturally and not formally or essentially, since God can ascribe to it what the monads do not give, and take away from it what they do give. The arguments which can be advanced against this will all be valid against the common doctrine of corporeal substance, or against everything substantial which can be superadded to the monads. Doubtless if there is something substantial besides monads, this ought to be capable of its own modifications, and it will have these naturally in dependence upon the monads which it unites, supernaturally from God, who can separate it from these monads. So while you say that it must have its modifications either from God by a perpetual miracle, or from the monads, I say it has them naturally and for the most part from the monads, but miraculously and rarely from God, who is able to make it respond to monads which were not formerly its own. If any real chain is possible, an influence of the units upon it is necessarily possible; otherwise there will be no reason for calling it a chain of these units. For the rest, it will not be necessary to assume a chain except in bodies which have a dominant monad, or which are unities per se like organic bodies, and this chain will always adhere to this monad.

Your other objection is the following:

> If all monads get their perceptions out of their own store, so to speak, and without any physical influence of one upon another; if, furthermore, the perceptions of each monad correspond exactly to the rest of the monads which God has now created, and to their perceptions; then God cannot have created any one of these monads which now exist without having constituted all of the rest, etc.

My reply is easy and has already been given. He can do it absolutely; he cannot do it hypothetically, because he has decreed that all things should function most wisely and harmoniously. There would be no deception of rational creatures, however, even if everything outside of them did not correspond exactly to their experiences, or indeed if nothing did, just as if there were only one mind; because everything would happen just as if all other things existed, and this mind, acting with reason, would not charge itself with any fault. For this is not to err. That the probable judgment which this mind formed of the existence of other creatures should be true, however, would no more be necessary than it was necessary that the earth should stand still because, with few exceptions, the whole human race once held this to be right. Not from necessity, therefore, but by the will of God does it happen that judgments formed upon the best appearances, and after full discussion, are true. . . .

XV

Des Bosses to Leibniz

[G., II, 500-502]

Cologne, July 20, 1715

. . . To reply to your last letter. I think with you that if there is some real chain in bodies, more distinct from the monads than a mode, and, if this is possible, there must necessarily be, or be possible, an influence of the units upon it. Otherwise, as you say, there would be no ground for calling it their chain. I also think it is not necessary to assume this chain except in bodies which have a dominant monad, or which are unities per se, like organisms, to whose monad or whole there should always adhere a chain. The monads therefore influence the reifying being; this latter, however, will bring about no change in the laws of the monads, since, whatever modifications it has, it will have from them as if an echo, as you have so carefully explained.

Yet from these things it seems we can conclude, in fact, that this chain, however real, cannot be substantial. For you hold that the substantial (or at least the nonmodal) is a power or principle of action, and this does not seem applicable to this real chain whose modifications are like echoes. Furthermore, once it is established that this chain is not substantial, the matter is settled and the way is wide open for explaining the Eucharist. Nor do I see why it should not be possible for something to be real which is not substantial; if this is possible, however, it has certainly not been overlooked by God in the production of the world, unless we accept what is called a vacuum of forms.

To your answer to my other argument, which was not unexpected, I answer in two ways. In the first place, even apart from the existence and wisdom of God, we seem able to conclude that, more than probably, there exist other creatures than ourselves. For will you deny that even an atheist has a knowledge of the existence of his own body? I remember that I once sent to you certain propositions prohibited in our schools by Michaelangelo Tambourino, who is today the head of our Society. Let me repeat here several of them which bear upon the present issue.

1. That the human mind can and should doubt everything except that it thinks.

2. That all other things can be known and examined by us only when we have acknowledged that God exists and is supremely good and not a deceiver who tries to lead our mind into error.

3. That, before the certain knowledge of the divine existence, one can and should always doubt whether he has not been so constituted by nature as to err in all his judgments, even in those which seem to be most certain and evident.

5. That it is only through faith in God that anyone can know with certainty that there exist other bodies, even his own.

My second point bears on the divine wisdom, about which I made a suggestion in my argument which you have not noticed or at least have left untouched. To expound this, I ask whether or not there be possible any system similar to the present world with respect to all phenomena but in which substances act upon each other. If you deny this, show me why; if you admit it, then I argue as follows. It seems in greater conformity with the divine wisdom to choose a system of this kind in preference to another composed of mere monads which do not influence each other. Therefore God has really established the former, not the latter, system. The consequent holds by your principles; the antecedent I argue for as follows. In the system of pre-established harmony, the whole reason for the divine architectonic wisdom (at least if we stay within natural events) consists in the choice of working materials. In the common system, however, it turns also about the form of the work and its composition, apart from the choice of material itself, so that it can be said that the work excels over the material, and this last seems preferable and more worthy of infinite wisdom. To illustrate this by an example, I ask further which architect will deserve credit for greater wisdom in his art, one whose entire craftsmanship consists in his choosing stones that are not only already exactly square but also so fitted to each other by their nature that a most magnificent palace is put together out of them because of the mere fact that they have been brought together in one place, without the further labor of architect or craftsman, just as the poets narrate that the Theban walls sprang up to the lyre of Amphion. Or is that architect rather to be preferred who constructs an equally beautiful palace from stones unfinished by nature and not corresponding to each other in such harmony, but which must be fitted by craftsmanship and adjusted in time and place? . . .

I add one point to the account. It seems gratuitous to assume these monads which draw all their modifications out of their own store, and without a physical influence of one upon another, just as the assumption proved gratuitous that there was a certain Scholastic quality whose nature it was to be produced and to produce all the effects of heat, for example, independently of any mechanism or of the concourse of the remaining bodies which surrounded it, etc. The more recent philosophers usually hiss such a quality from the stage. . . .

XVI

Leibniz to Des Bosses

[G., II, 502-5]

Hanover, August 19, 1715

Your observations are keen, and I reply to them with pleasure, for they instruct me and throw light on the problem. I shall begin with the latter part. We conclude with the highest probability that we are not the only existents, not only from the principle of the divine wisdom, but also from that common principle which I have frequently urged—that nothing happens without a reason; for there appears to be no reason why we alone should be preferred above all other possible beings. But whether bodies are substances is another question. For it is possible that bodies are not substances, yet that all men are prone to consider that they are, just as everyone is prone to consider that the earth is standing still, even though it is really moving.

I do not recall that you sent me the propositions prohibited by your general president, Tambourino. Those which you now send me seem to be in opposition to Descartes, and I agree fully with them. You give the fifth but omit the fourth. I should be glad to get them all. Honoratius Fabri, in certain published letters, recounted the prohibitions in effect when he was active.

I do not believe a system is possible in which the monads act upon each other mutually, for there seems to be no possible way to explain such action. I add that influence is superfluous, for why should one monad give another what it already possesses? It is the very nature of substance that the present is great with the future and that everything can be understood out of one, at least if God does not intervene with a miracle.

In reply to your analogy, I admit that the architect who rightly fits stones together acts with greater art than one who has found the stones already so prepared by someone else that they fall into order when merely brought together. But, on the other hand, I believe you will admit that the craftsmanship of the architect who can so prepare stones in advance will be infinitely greater still.

As an addition you say that it is gratuitous to assume monads which receive their modifications from their own resources, just as it is gratuitous to say that heat acts without a mechanism. But your point here is not merely an addition; it is primary. If you think this, we must go back to the beginning, as if I had written nothing. Besides, monads draw everything from their own resources, not mysteriously, as heat in the Scholastic sense produces its effect, but by a certain eminent mechanism, so to speak, which is the foundation and the concentration of the bodily mechanism; thus the way in which the one follows from the other can be explained.

I was right in presupposing this, for if there are no monads such as I think of them, it is vain to discuss a chain of them. I come now to the question of whether this chain, if there is one, is something substantial. It seems so to me, and I consider it useless otherwise, for how could it otherwise make up a composite substance, this being the very reason for which it was introduced? But you object, first, that it is not a principle of action, since it is like an echo. I also reply that a body which returns an echo is a principle of action. This chain will be the principle of action of composite substance, and whoever admits such substance—as does the entire School, if I am not mistaken—will also admit this chain. Have not the Scholastics until now acknowledged substantial principles in compounds which constitute a unity per se? Why then deny it to us?

You say that you cannot see why something cannot be real without being substantial. Here we may be arguing about terms. Whatever is not a modification can be called a substance. But a modification is connected essentially to that whose modification it is. So there can be no modification without a subject; for example, no sitting without a sitter. But substantial can also be defined in another way, as the source of modifications. Assuming this, we m ask whether there can be a thing which is neither a modification nor a source of modifications—such as the Scholastics think of as acciden which, they say, are in a subject naturally but not essentially, since they can be without a subject by the absolute power of God. But I do n yet see how such a thing can be explained if it is different from my su stantial chain, which is truly in the subject, though not as an accident but as what the Scholastics call a substantial form, or as a source of modifications—if you like, after the manner of an echo. So I do not know whether there may be a categorial accident [*accidens praedicamentale*] really distinct from the subject, which is not a categorial accident, or whether there is a categorial accident which is not a modification; since I have already questioned that there is a categorial accident distinct from a subject, which is not a modification. Unless perhaps someone should hold that an accident makes up such a composite substantial being because it is not a primary source but an echo. But in this way I do not see how we can maintain the substance of a composite being, unless we want to regard substance as the result of accidents. In that case, however, I do not see how you explain participation. Therefore I should prefer to say that there are no substances over and above monads, but only appearances, but that these are not illusory, like a dream, or like a sword pointing at us out of a concave mirror, or like Doctor Faust eating up a cartful of hay, but that they are true phenomena, that is, in the sense that a rainbow or parhelion is an appearance, and, in fact, in the sense that colors are appearances according to the Cartesians and in reality. It can be said that composite beings which are not a unity per se or are not held together by a substantial chain or (as the jurisconsult Alfenus, following the Stoics, said in his *Digests*) by one spirit are semientities. Aggregates of simple substances such as an army or a pile of stones are semientities; colors, odors, tastes, etc., are semiaccidents. All these things would be mere phenomena, though real, if there were only monads without substantial chains.

Furthermore, to have monads, or to have such monads, is itself natural, though not essential but only accidental, to composite substance. For it could happen that the absolute power of God should cause the echo to cease, and the monads would be separated from the composite substance. If then, according to your hypotheses, the substantial chains of organic bodies, or of the unities per se included in the bread and wine, were destroyed by God, while the monads and phenomena remained, the accidents of bread and wine would be left, but only as mere phenomena, not by some illusion but in such a way as would happen everywhere if there were no substantial chains in nature. For certainly everything will continue in the same way with respect to these monads of bread and wine as if there had never been any substantial chain between them. But the substantial chains of the monads of the body of Christ will have an influence upon the substantial chains of the monads of our body, which they would otherwise have had on the substantial chains of bread and wine, with the result that we perceive the substance of the body and blood of Christ. For the substantial chains of the former monads will have been removed, and, after the phenomena of bread and wine have ceased or their appearances are destroyed, they cannot be restored such as they previously were but only as they would have developed if no destruction had taken place.[323] . . .

SUPPLEMENT TO LETTER XVI

A permanent absolute creature, which therefore is neither activity-passivity nor relation, is:

- A unity per se; a full being
  - Substance
    - Simple, a monad, like minds, souls, which are subject to no influence by other creatures.
    - or
    - Composite (like animals or other organic beings) which always remains unchanged and adheres to a dominant monad but is subject to the influence of other composite substances. It consists of active and passive power originally, or consists of primary matter, i.e., the principle of resistance, and of substantial form, i.e., the principle of impetus. For we must recognize that new force is not given to bodies but that the force inherent in them is merely determined or modified by others. When one body collides with another, it impels that body by determining the inherent elastic force which arises from internal motion, in a way that can be seen when two equal inflated balls, colliding with equal velocity, are restored to rest through the collision and then resume motion through their inherent elastic force. The same thing happens in every collision, for nature never acts through a leap, nor does any body ever make a sudden transition from rest to motion or from faster to slower motion, or the opposite; it changes by intermediate steps, and this happens through elastic force or the motion of a fluid permeating it.
  - or
  - Modification
    - Of a monad, which arises from its own resources and consists exclusively of perception and appetite.
    - Of composite substance, which arises out of this mutual influence and consists of derivative active and passive powers when bodies collide according to the laws of motion, that is, in forces and resistances throughout their magnitudes and figures.
- or
- A unity by aggregation, a semibeing, or phenomenon
  - Semisubstance, a collection of substances, such as the choir of angels, an army of men, herd of animals, a fishpond, house, a rock, a cadaver. Hence they are:
    - Devoid of cohesion (herd, group)
    - or
    - Possessed of cohesion (pond, house)
    - Both are
      - Natural (heap of sand, rock, tree trunk)
      - Artificial (army, house)
  - Semiaccident; appearance or collection of the modifications of substances
    - Primary or united; i.e., derivative power
      - Passive, resistance through magnitude and figure; in other words, throughout its determinate texture.
      - Active impetus
    - Secondary or physical, whose reason depends on an occult mechanism, a sensible accident, as it were: color, odor, taste; also sympathy, antipathy, etc. Such a quality is in turn
      - Passive, such as firmness, fluidity, roughness, malleability; and perceptible
        - Immediately, as warmth, gravity, hardness
        - By its effect, such as magnetic and elastic force, volatility
      - Active, a
        heat, col
        gravity,
        elasticit

CONVERSATION OF PHILARÈTE AND ARISTE, FOLLOWING A CONVERSATION OF ARISTE AND THEODORE

Ca. 1711

It is significant that, at the same time at which he was defining his thought in Scholastic forms in the correspondence with Des Bosses, Leibniz had not abandoned the more popular exposition of his views in relation to Cartesian thought. This dialogue is the most successful of several criticisms of Malebranche; in form it is a continuation of that thinker's Entretiens sur la métaphysique et sur la religion, published in 1688.[324] In this work Malebranche himself appears as Theodore, who had expounded his opinions to Ariste; Leibniz's views are presented by Philarète.

The exact date of the dialogue is not known, though it seems to have been written shortly after the Theodicy. In 1715 Leibniz sent it to Remond (see the letter of July 29, 1715 [G., III, 647]) as "a little dialogue on some opinions of the Reverend Father Malebranche." Des Maizeau, who received it from Remond, published it in 1720 with the title Examen des Principes du R. P. Malebranche; Leibniz's own manuscript bears the title translated above.

* * *

[G., VI, 579-94]

After Theodore had left, Ariste received a visit from his old friend Philarète, a highly esteemed doctor of the Sorbonne who had once taught philosophy and theology in the Scholastic manner but who nonetheless did not scorn the discoveries of the moderns but approached them with much caution and accuracy. He had entered into a kind of retreat in order the better to give himself to the exercises of piety, and at the same time he was at work putting the truths of religion in their true light, seeking to correct and to perfect their proofs. This led him to a rigorous examination of the proofs which were developed, to determine how they needed to be strengthened.

Ariste, seeing him, cried out: What an appropriate time for you to call, my dear Philarète, after so long an interruption of our acquaintance. I have just ended a charming discussion at which I wish you might have been present. That profound philosopher, that excellent theologian, Theodore, has completely carried me away. He has taken me out of this corporeal and corruptible world into one intelligible and eternal. Yet, when I think without him, I fall back easily into my old prejudices, and sometimes I do not know where I stand. No one is more able than you to fix me and to enable me to decide surely and with coolness, so to speak. For I must confess that the great and beautiful expressions of Theodore stir and elevate me but that, after he leaves me, I no longer know why I was lifted so high, and I feel a kind of dizziness which confuses me.

Philarète. I am well acquainted with Theodore's worth through his works, which contain great and beautiful thoughts; many of them have been well verified, but there are also some, and these among the most fundamental, which still need further clarification. I have no doubt that he has told you a thousand things fitted to help you in the excellent plan which I hear you have formed of leaving the vanities of the world, the deafening noise of people, and the vain and often evil conversations of the worldly, to give yourself up to such sound meditations as bind us to virtue and lead us to happiness. What I have heard of this happy change of yours has led me to pay you this visit to renew our old ties, and you could not have given me a better opportunity to begin and to show you my devotion than by speaking at once of the very things which have been the object of my own thinking for a long time and which should be one of the most interesting objects of yours. If you could recall the substance of Theodore's conversation, perhaps I could help you develop some of the concepts which he has given you, and he will himself finish by clarifying and grounding afterward whatever still seems obscure or doubtful to you.

A. I am delighted with your help, and I shall try to summarize in substance what Theodore has told me. But do not expect from me the charm attached to everything which he said. He undertook first to show me that the I who thinks is not a body, since thoughts are not in any sense modifications of extension, and it is in extension that the essence of the body consists. I asked him to prove to me that my body is nothing but extension; when I heard him, it seemed to me that he did prove it, but his proof has somehow escaped me. It will return bit by bit, however. Extension, he told me, is all that is needed in order to form the body. He added also that, if God were to destroy extension, the body would be destroyed as well.

Ph. Philosophers who are not Cartesians will not agree that extension is enough to form a body; they will demand something more which the ancients called antitypy, that, namely, which makes one body impenetrable to another. According to them, bare extension is only the place, or the space, which the body occupies. It seems to me, in fact, that when Descartes and his followers try to refute this opinion, they merely make assumptions—or, to call the thing by its name, they beg the question.

A. But don't you find that, since the assumption of the destruction of space involves that of body, it proves that body consists only of extension?

Ph. It proves only that extension enters into the essence of nature of a body but not that it is its whole essence; just so, magnitude enters into the essence of extension but does not suffice for extension, since number, time, and motion also have magnitude yet are different from extension. If God were to destroy all actual magnitude, he would destroy extension, but, in producing magnitude, he might produce only time, without producing extension. Likewise with extension and body—in destroying extension, God would destroy body, but, in producing only extension, he might perhaps produce only space without body, at least according to men whom the Cartesians have not yet well refuted.

A. I am sorry not to have noticed this difficulty at once, but I shall make a note to suggest it to Theodore. However, if I remember rightly, he gave me yet another argument tending toward the same conclusion, but this one seemed very subtle to me, since it was taken from the nature of substance. Theodore proved to me that extension is a substance and, I believe, tried to infer that body could be only extension, since otherwise it would consist of more than one substance. But I should not guarantee that this was Theodore's argument. I can be deceiving myself into giving his words a context different from what was in his mind; I shall find out about this.

Ph. I find some difficulty, once more, in this conclusion which you attribute to Theodore, even if only with some misgiving. For you know that the Peripatetics regard a body as composed of two substantial principles, matter and form. So we should have to prove that it is impossible for a body to be composed at once of two substances, that is, of extension—if we agree that extension is a substance—and of some other substance as well. But let us see how Theodore proved that extension is a substance; this is a very important point.

A. I shall try to remember. Whatever one can conceive by itself, without thinking of anything else, or without using the idea which represents something else, or, better, whatever one can conceive by itself as existing independently of anything else, is a *substance.* And whatever one cannot conceive alone, or without thinking of some other being, is a mode of being, or a *modification of substance.* This is what we mean when we say that a substance is a being which subsists in itself. We have no other way to distinguish substances from modifications. Now Theodore showed me that I could think of extension without thinking of anything else.

Ph. This definition of substance is not free from difficulty. In the end only God can be thought of as independent of any other being. Shall we say then, as does a certain innovator who is only too well known, that God is the only substance and that created beings are only his modifications?[325] But, if you restrict your definition by adding that substance is that which can be conceived independently of every other creature, we may perhaps find things which have as much independence as extension and yet are not substances. For example, active force, life, and antitypy are something essential and at the same time primitive, and one can conceive of them independently of other concepts, even of their subjects, by means of abstractions. Subjects, on the contrary, are conceived by means of such attributes. Yet these attributes are different from the substances of which they are attributes. So there is something which is not at all substance, yet which cannot be conceived as any more dependent than substance itself. Hence this independence on the part of its concept is not at all the mark of substance, since it must apply also to what is essential to substance.

A. I believe that abstractions ought not to be thought of as independent of something, at least in their subject which should be concrete even though it is incomplete, and which, when joined to a sufficient essential primitive attribute, would make up the complete subject. But to get ourselves out of these thorns, let us say that the definition ought to apply only to concretes; thus substance would be a concrete being independent of every other created concrete being.

Ph. Then you place another restriction on your definition; but it still contains great difficulties. For (1) perhaps the explanation of what "only concrete" means presupposes substance itself, so that you will be reasoning in a circle in your definition. (2) I deny that extension is a concrete term, since it is an abstraction from what is extended. (3) It follows that the exact and incomplete subject, or the simple, primitive concrete term which, joined to an essential attribute, constitutes a complete substance, would itself alone deserve the name of substance, since neither the abstractions nor the complete concretes could be conceived or could exist without it. (4) I shall not insist, for the present, on the doctrine of those theologians who maintain that accidents can exist without their subject in the sacrament of the Eucharist, for they are essentially independent of it, and your definition therefore covers them.

A. We are being plunged into plenty of subtleties, and it is a good thing that I was once in the College and have retained some of the Scholastic terms. But I admit that these subtleties are unavoidable here and that you put them in a very intelligible way so that I find it possible to reply to you. I answer, then, to the first point, that the definition of the concrete does not require that of substance, since accidents too can be concrete.[326] For example, heat can be great or have magnitude, but great is a concrete entity. A number can be called great, or proportional, or commensurable, etc. As for the second point, I should say that, since extension, space, and body are one and the same thing for Theodore, he will say that extension is a concrete being. I reply to the third point that the extended being, or the body, is exactly this primary subject conceived as the matter which is formed by shapes and motions into a complete subject. Finally, I say to the fourth point that Theodore may not agree with the possibility of the existence of accidents without a subject. Others who may wish to maintain the definition will say that substance is a concrete being which is naturally independent of every other created concrete being.

Ph. I find your reply to the first point good. Yet you must explain the concept of concrete and abstract more distinctly. But, on the second point, I cannot agree with you that the extended and extension are the same thing. There is no example in created beings of the identity of the abstract and the concrete. Your reply to the third point can pass, and also that which you gave to the fourth, according to those who deny that accidents subsist outside of a subject. But those who would correct the definition of substance by limiting it to what occurs *naturally* will make it resemble the definition of man which is ascribed to Plato. It is said that he had defined man as a two-legged animal without feathers; whereupon Diogenes plucked a cock and threw it into Plato's lecture hall, saying, "Here is a Platonic man." A Platonist could have replied that the definition meant an animal as it is *naturally*. But we require that definitions be drawn from the *essence* of things. It is true that definitions may also be useful which are drawn from that which occurs naturally, and that one can distinguish three levels of predicates: the *essential*, the *natural*, and what is simply *accidental.*[327] In metaphysics, however, one seeks essential attributes or those drawn from what we call a formal reason.

A. So far as I see, the only question at issue between us is whether extension is an abstract or a concrete being.

Ph. I could also object to your definition that bodies are not at all independent of each other and that they need, for instance, to be acted upon or stimulated by their surroundings. But you could make use of my own answer in replying to me, namely, that the essence is all that is needed for a definition, since God can cause bodies to be independent and conserve them in their state when every other body has been destroyed. So I merely insist on my earlier remark—that extension is nothing but an abstraction and demands something which is extended. It needs a subject; it is something relative to this subject, like duration. In this subject it even presupposes something prior to it. It implies some quality, some attribute, some nature in the subject which is extended, which is expanded with the subject, which is continued. Extension is the diffusion of that quality or nature. For example, there is in milk an extension or diffusion of whiteness, in the diamond an extension or diffusion of hardness, in body in general an extension or diffusion of antitypy or of materiality. You will thus see at once that there is something in body prior to extension. One may say that in some way extension is to space as duration is to time. Duration and extension are attributes of things, but time and space are taken by us to be something outside of things and serve to measure them.[328]

A. Those who admit a space distinct from body think of it as a substance which constitutes position. But the Cartesians and Theodore think of matter itself as you think of space, except that they give it a mobility along with extension.

Ph. Then they tacitly admit that extension is not sufficient to constitute matter or body, since they have to add mobility, which is a result of antitypy or of resistance; otherwise one body could not be pushed or moved by another.

A. They will say that mobility is a result of extension, since all extension is divisible in such a way that its parts are therefore separable from each other.

Ph. Those who assume that there is vacuum, or at least a real space distinct from the matter which fills it, will not grant you this conclusion. They will say that one can note the different parts in space but that one cannot separate them. As for my own view, though I distinguish the notion of extension from that of body, I still believe that there is no vacuum and even that there is no substance which can be called space, i. e., that there is no subject having only the attribute of extension. Even if I were to admit such a substance,[329] I should always distinguish between the extended or extension, and the attribute to which being extended, or diffusion, a relative concept, is referred. This would be situation or locality. Thus the diffusion of place forms space, which would be the first ground [πρῶτον δεκτικόν][330] or the primary subject of extension, and by which it would also apply to other things in space. Thus extension, when it is an attribute of space, is the diffusion or continuation of situation or locality, just as the extension of a body is the diffusion of antitypy or materiality. For there is position in a point as well as in space, and as a result there can be position without extension or diffusion, but diffusion in simple length constitutes a localized line endowed with extension. The same thing is true of matter; it is in a point as well as in a body, and its diffusion in simple length makes a material line. Other continuations or diffusions in breadth and depth form the surface and the solid of geometry—in a word, space in relations of position, and body in material relations.

A. These relations of proportion between position and matter, space and body, please me. They help one speak with exactness. It is good to make these distinctions, and similarly that between duration and time, extension and space, as well. I shall have to ask Theodore about this.

Ph. Finally, to go further still, I hold the opinion that not only extension but body as well cannot be thought of independently of other things. Thus we should have to say either that bodies are not substances at all or that it is not a property of all substances to be thought of as independent, even though it may be of some single substances. For being a whole, the body depends essentially[331] upon other bodies of which it is composed and which constitute its parts. Only the *monads*, that is, simple or indivisible substances, are truly independent of every concrete created thing.

A. Then I shall say that *substance* is a concrete being independent of every concrete created thing outside of itself. Thus the dependence of a substance upon its own attributes and parts will be no obstacle at all to our arguments.

Ph. But that makes the third restriction upon your definition. It is permissible for you to do this, of course, but, to tell the truth, some things which are permissible are not expedient; *non omne quod licet expedit*. What does it matter if the worm which gnaws at me is within me or outside of me? Am I any the less dependent upon him? Only incorporeal substances are independent of every other created substance. So it seems that in philosophical strictness the body does not deserve the name of substance, a view which seems to have been Plato's, who says that there are transient beings which never subsist longer than a moment. But this point needs a fuller discussion, and I have still other important reasons for refusing to bodies the title and name of substances in a metaphysical sense. For to say a word about this, a body is not a true unity; it is only an aggregate, which the Scholastics call a being *per accidens*,[332] a collection like a herd. Its unity comes from our perception. It is a being of *reason* or, rather, of *imagination*, a *phenomenon*.[333]

A. I hope that Theodore will satisfy you on all these difficulties. Meanwhile let us assume that body and extension are not so very different, since you do not recognize a vacuum; or at least let us lay the point aside for a fuller discussion and go on to the rest of Theodore's demonstration. It reduces to this. Everything which has modifications which we are unable to explain by extension is distinct from a body, assuming that bodies and extension are the same thing or at least that they differ only as space and that which has only to fill it—that which has some resistance and mobility in addition to extension, as you seem to grant. Now the soul has modifications which are not modifications of extension or, if you please, of antitypy or of simple space-filling. Theodore even proves this; for my pleasure, my desire, and all my thoughts are not at all relations of distance, and one cannot measure them by feet or inches, like space or that which fills it.

Ph. I share Theodore's opinion when he maintains that the modifications of the soul are not at all modifications of matter and that as a result the soul is immaterial. Yet his proof still contains some difficulty. He holds that no thoughts are relations of distance, since we cannot measure them; but a follower of Epicurus would say that this is due to our faulty knowledge of them and that, if we knew the corpuscles which form thought and the movements necessary for it, we would see that thoughts are measurable and are the workings of certain subtle machines. Just so, the nature of color does not seem to consist, internally, of some measurable thing. Yet if it is true that the reason for such qualities in objects is to be found in certain configurations and movements—as the whiteness of foam, for instance, comes from little bubbles which are hollow and polished like many little mirrors—then these qualities may at last be reducible to something measurable, material, and mechanical.

A. In this way you abandon to your opponents all the proofs which can be given for the distinction of soul and body.

Ph. Not at all. I intend merely to perfect them. To give you a little sample now, I consider that matter includes only what is passive. It seems to me that the Democriteans as well as other philosophers who think mechanistically must agree with this. For not only extension but also the antitypy attributed to bodies are purely passive things, and as a result the origin of action cannot be a modification of matter. Hence movement as well as thought must come from another source.

A. Permit me to point out the fault I find in your argument, for you teach me to be exact to the point of rigor. I shall say, then, that your argument is of no value except *ad hominem*, that is, for those who philosophize like Democritus and Descartes. But Platonists and Aristotelians, and some of the recent defenders of an archeus, as well as the latest sympathists who maintain the attraction of bodies at a distance,[334] put qualities in the body which cannot be explained mechanically; they will therefore not agree that bodies are purely passive. I recall that a certain author, one of your friends, favors the purely mechanical explanation of bodily phenomena but has undertaken in some essays published in the *Acta eruditorum* of Leipzig to show that bodies are endowed with a certain active force and that bodies are thus composed of two natures—a primitive active force (called first entelechy by Aristotle) and matter or primitive passive force, which seems to be antitypy. He holds, for this reason, that everything can be explained mechanically about material things except the principles of mechanism themselves, which cannot be derived from the consideration of matter alone.

Ph. I am corresponding with this author and am fairly familiar with his opinions. This primitive active force, which could be called *life*, is precisely what is contained, he holds, in what we call a soul or in simple substance. It is an immaterial, indivisible, and indestructible reality; he locates it everywhere in the body, believing that there is no part of matter where there is not an organized body endowed with some perception or with a kind of soul. Thus this thinking leads us straight to the distinction of soul and matter. If one calls *body* what I should prefer, as does he, to call *corporeal substance*, which is composed of soul and matter, this is merely a question of terminology. This active force is exactly that which best shows the difference between soul and matter, and that in a sensible way, because the principles of mechanism, of which the laws of motion are the result, cannot be derived from what is purely passive, geometrical, or material or proved by the axioms of mathematics alone. For this author has pointed out in more than one article in the Paris *Journal des savants*, the Leipzig *Acta eruditorum*, and elsewhere when speaking of his dynamics, and even recently in his *Theodicy*, that, to justify the laws of dynamics, one must have recourse to a real metaphysics and to the principles of harmony which pertain to souls and which are no less exact than those of geometry. In the letters which he has exchanged with Mr. Hartsoeker and which are published in the *Mémoires de Trévoux*, you will also find how he abolished the void and atoms through higher considerations, even making use in this of a part of dynamics.[335] Those who instead merely restrict their considerations to matter cannot reach a decision on this question. This is why the new philosophers, being usually too materialistic and not inclined to ally metaphysics with mathematics, have been in no position to decide whether there are atoms and a void or not. Many have even been led to believe that there are, that is to say that there exist, either a void and atoms or at least atoms swimming about in a perfect fluid, thus excluding the void.[336] But he shows that the void, the atoms, or perfect hardness, and a perfect fluid are all alike opposed to harmony and order.

A. There is something in what you say, and with your assistance I want to think more about it, especially about dynamics, since it is so important for the knowledge of immaterial substances, and about the inconsistency of the void and atoms as well. But I have still another objection. This is that God could himself have done immediately everything that you attribute to souls. Thus the modifications and the operations which go beyond matter would not lead you to souls distinct from matter, since they would be the acts of God himself. It is true that this objection applies also against Theodore himself, and perhaps more than against the others, for as you know he considers secondary causes as only occasional.

Ph. Even if the operations in question were acts of God, the modifications which are attributed to souls and which we feel in our own soul could not be modifications of God. And, as concerns operations too, it cannot be denied that we ourselves have internal actions, and this would be all that is necessary here, since matter, being passive, is incapable of such activity. But the viewpoint which ascribes all external actions to God alone has recourse to miracles, and even to unreasonable miracles, hardly worthy of the divine wisdom. By the same right by which we set up such fictions which only a miraculous omnipotence of God could make possible, it would be permissible to maintain that I am alone in the world and that God produces all the phenomena in my soul as if there were other things outside of me, without there actually being any. Yet even if our present argument, which proves the distinction between soul and matter insofar as this is supported by external operations or in dynamics, were valid only on the assumption that things take place in the ordinary course of nature by natural forces, without God acting upon them except to conserve them—even this would be a great gain. For it would prove either the distinction between the soul and the body or the existence of God. We can go even further and show more distinctly how dynamics verifies both of these two great doctrines, but that would demand a more extended discussion in which we need not now get involved.

A. We must talk of this again some other time at your convenience. However, I find that we have already achieved much, since the opponents of religion cannot refute what you have just said in favor of the immortality of souls without recourse to God, that is, to the doctrine which they most abhor. But once convince them of the existence of God, or of a spirit infinitely powerful and wise, and it will not be hard to infer that he has also made finite spirits immaterial like himself and, further, that God would not be just if our souls perished with their bodies.

Ph. There is even good ground for doubting whether God has made any other things than monads, or substances without extension, and whether bodies are anything but the phenomena resulting from these substances. My friend, whose opinions I have detailed to you, gives evidence enough of leaning to this view, since he reduces everything to monads or to simple substances and their modifications, along with the phenomena which result from them and whose reality is established by their relations, which distinguish them from dreams. I have already touched somewhat on this; but now I must hear the rest of your estimable Theodore's conclusions.

A. After having established the distinction between soul and body as the basis of the chief doctrines of philosophy, and also of the immortality of the soul, he drew my attention to the ideas perceived by the soul; he maintains that these ideas are realities. He goes even further and holds that the ideas have an eternal and necessary existence and that they are the archetype of the visible world, whereas the things which we think we see outside of us are often imaginary and always transitory. He even advanced the following argument. Suppose that God should annihilate every being he has created except you and me; suppose further that God gives our spirit the same ideas which now present themselves through the presence of objects; we should then see the same beauties which we see now. Hence the beauties which we see are not material but intelligible beauties.

Ph. I fully agree that material things are not the immediate objects of our perception, yet I find some difficulty in the proof and in the way in which he explains the matter, and I wish it might be developed a little better. The hypothetical major premise of the argument: Does it contain inevitable consequence? If we should see everything in an intelligible world in case external things were destroyed, it follows that we see everything in an intelligible world at present too. Is this conclusion, I say, certain? Is it not at all possible that our present ordinary perception is of a different kind from this extraordinary perception? The minor premise is that in the case of this destruction, we should see everything in an intelligible world. But to many people this minor premise would also seem doubtful. Would not the opponent who believes that bodies have an influence on souls say that, in case our bodies were destroyed, God would supply their lack and would produce in our souls the qualities which the bodies would have produced, without any need of eternal ideas or an intelligible world? But even granting that everything takes place in us ordinarily just as it would in the case of bodily annihilation, that is, admitting that we ourselves always produce within us (as I in fact believe) or that God produces in us (as Theodore believes) internal phenomena without the body having any influence over us, must this necessarily involve external ideas? Is it not sufficient to hold that phenomena are simply new transitory modifications of our souls?[337]

A. I cannot recall that Theodore ever proved to me in general that the ideas which we see are eternal realities. He undertook this only with regard to the idea of space and by a particular line of reasoning. But this itself always predisposes me to conclude the same thing about the ideas of other things, since space is very often a part of them. He also gave excellent answers to the arguments with which I opposed his view. I objected that the earth offers resistance to me and that there is something solid in this. He replied that this resistance could be imaginary, as in a vivid dream, whereas the ideas do not deceive. He also showed me, very fittingly, that, if resistance is a mark of reality, there is also resistance in the ideas, when one tries to ascribe to them that which they cannot endure.[338] But, as I have already said, he proved to me that the idea of space is necessary, eternal, immutable, and the same in all minds.

Ph. One may agree with you, Sir, that there are eternal truths, but not everyone will agree that there are eternal realities which are presented to our soul when it sees these truths. It will be said that it is enough that our thoughts have a relationship in this with those of God, in whom alone the eternal truths are realized.

A. Yet this is the argument which Theodore offered to prove his thesis. When we have the idea of space, we have the idea of infinity; but the idea of infinity is infinite, and an infinite thing cannot be the modification of our soul, which is finite;[339] hence there are ideas which we see but which are not modifications of our souls.

Ph. This argument seems to me worth considering, and it ought to be developed more thoroughly. I agree that we have the idea of an infinite in perfection; for that we need only to think of the absolute, by setting aside all limitations. And we have a perception of that absolute because we participate in it, inasmuch as we have some share of perfection. But one can doubt with reason if we have an idea of an infinite whole or of an infinity composed of parts, for a compound being cannot be an absolute. It may be said, for example, that every straight line can be thought of as prolonged or, better, that there is always a straight line greater than the given one, yet we do not have the idea of an infinite straight line or of one greater than all others which can be given.

A. It is Theodore's opinion that the idea we have of extension is infinite but that the thought which we have of it, which is a modification of our soul, is not.

Ph. But how prove that we must have anything more than our thoughts and their objects within us and that an infinite idea existing in God is needed for our purpose, in order to have only a finite thought? Would it not be enough, if we must have ideas distinct from thoughts, for the ideas to be proportional to the thoughts? We must say, then, that there is no way of understanding such ideas.

A. This is the way which Theodore provided for me. The mind does not see the infinite in the sense that it measures it by its thought. But neither is it enough for the mind not to see the end to its thought, for it could still hope to find such an end; but it understands that there is no such end. Thus the geometricians see that subdivision, though continued as far as you please, will never reveal any part of the side of a square, however small, which can also be some part of the diagonal or commensurate with it. Similarly, these geometricians see asymptotic lines which they know can never intersect the hyperbola, though they approach it without end.

Ph. This method of knowing the infinite is certain and incontestable. It proves, too, that objects have no limits. But though we can conclude from it that there is no ultimate finite whole, it does not follow that we see an infinite whole. There is no infinite straight line, but every straight line can always be prolonged or surpassed by another longer one. Thus the example of space does not at all prove in particular that we need the presence of certain subsisting ideas different from the passing modes of our thought. It seems at once that our thoughts are themselves sufficient for this.

A. It is not myself that I see when I see space and figures; therefore, it is something outside of myself.

Ph. Why should I not see these things in myself? It is true that I see their possibility even when I am in no way aware of their existence and that, even when I do not see them, these possibilities always subsist as eternal truths whose whole reality must, however, be founded in something actual, that is to say, in God. But the question is whether we have ground to say that we see them in God. Yet since I myself must applaud Theodore's beautiful thoughts, I think one can justify his opinion on this problem, in the following way, though it appears highly paradoxical to those who have not lifted their minds above sense perception. I am convinced that God is the only immediate external object of souls, since there is nothing except him outside of the soul which acts immediately upon it. Our thoughts with all that is in us, insofar as it includes some perfection, are produced without interruption by his continuous operation. So, inasmuch as we receive our finite perfections from his which are infinite, we are immediately affected by them. And it is thus that our mind is affected immediately by the eternal ideas which are in God, since our mind has thoughts which are in correspondence with them and participate in them. It is in this sense that we can say that our mind sees all things in God.

A. Far from displeasing Theodore, I hope that your criticisms and interpretations will please him. He delights to communicate with others, and the account which I shall bring him will give him an opportunity to share more and more of his insights with us. I even flatter myself that I can oblige both of you by bringing you together and that I myself would derive the most profit from this.

65

REMARKS ON THE THREE VOLUMES ENTITLED CHARACTERISTICS OF MEN, MANNERS, OPINIONS, TIMES, . . . 1711

1712

Upon its appearance in 1711, Shaftesbury's *Characteristics* was sent to Leibniz by Pierre Coste, who had been given a number of copies to distribute to scholars for criticism (Coste to Leibniz, April 14, 1712 [G., III, 420]). Leibniz's favorable reaction to the witty and penetrating observations of this English intuitionalist throws interesting light upon the relation of his own thought to the gospel of feeling of succeeding decades. Leibniz himself wrote to Thomas Burnet on August 23, 1713:

> The Count of Shaftesbury, who died recently in Naples, presented me with his three octavo volumes, which were full of beautiful things, and asked for my criticism. I was surprised to find a great number of thoughts which agree with my own principles. Yet I did add some slight criticisms, and he had the sincerity and moderation to tell me that my small corrections did not displease him. The loss of so excellent and sublime a mind is no small one [G., III, 327].

Leibniz sent his comments to Coste, who passed them on to Masson. They were published in the latter's *Histoire critique de la république des lettres* in 1715.

* * *

[G., III, 423-31]

The Letter on Enthusiasm contains a thousand beautiful thoughts. I believe that raillery is a good protection against this vice, but I do not find it suitable for curing people of it. On the contrary, the contempt which is clothed in raillery will be taken by them as affliction and persecution. I have observed that, when one rails at errors and absurdities in religious matters, one infinitely irritates the people at whom the raillery is directed and that this is the true way to pass for an atheist in their minds. Also, I am not sure that the use of ridicule is a good touchstone of error, since the best and most important matters can be turned to ridicule, and it is not always certain that truth will have those who laugh on its side, since it is most often hidden from vulgar eyes. I have already said that all raillery includes a little contempt, and it is not just to try to make contemptible what does not deserve it. But it is good always to be in good humor, so that joy will be apparent rather than irritation in our conversation and writing. The Essay on Free Manners, on Spirit, and on Good Humor seems to have the same purpose of bringing our contemporaries to humanize themselves and to brighten things; by its arguments and its example this work is wonderfully suited to the purpose. Though ironical, the remarks at the beginning in support of those who hold men to be wolves to each other, and against those who believe in their natural goodness, are pleasantly turned. But it can be said that ordinarily men are neither very malicious nor very good, and Machiavelli has well remarked that the two extremes are equally rare, with the result that great actions are rare also.

The Iroquois and Hurons, uncivilized neighbors of New France and New England, have upset the too universal political maxims of Aristotle and Hobbes. By their surprising conduct they have shown that entire peoples can live without magistrates and without quarrels and as a result that men are neither carried far enough by their natural goodness nor forced by their malice to provide themselves with a government and so to renounce their freedom. Yet the roughness of these savages shows that it is not so much necessity as the inclination to advance to a better state and to arrive at happiness through mutual assistance which is the foundation of societies and states. But it must be admitted that security is the most essential point in this.[340]

I find good the remark on page 98 that true virtue should be disinterested, that is, as I interpret it, that one should come to find pleasure in the practice of virtue, and disgust and repugnance in the exercise of vice, and that this should be the goal of education.[341]

The remark on page 99 is also good—that individual friendships are little recommended in our religion, which points us to charity or to general benevolence. It can also be said that a tested friendship is very rare and that it must be the effect of a great and beautiful passion or of a great virtue found in two persons at the same time. It is true that true friends who are very virtuous would be capable of going far.

Our illustrious author is right in refuting those (on p. 109) who believe that there is no obligation in a state of nature or outside of government. For, according to the authors of these principles, obligations by compact should form the right of government itself; so it is obvious that the obligation is prior to the government which it must form.

It is a common saying that interest governs the world, but there is truth in the remark on page 115 that it is rather the passions that do so. The Duke de Rohan begins his book on politics with this sentence: The princes command peoples, and interest commands the princes.[342] It would be desirable for this to be true, for then we should listen the better to reason. But reason demands also that we be concerned with our satisfaction beyond merely mercenary interest; it orders us to strive for happiness, which is nothing but a state of enduring joy. And whatever achieves this is our true interest.

As for those of whom he speaks on page 118, who refer everything to themselves and who seem to be in opposition to men who love their friends, parents, country, state, and even mankind in general, I believe that, rightly understood, we can reconcile the two positions provided that both sides listen to reason. Our own good is without doubt the basis of our motives, but very often we find that not only our own advantage but even our pleasure is in the good of someone else; in the latter case we should properly call this disinterested love, as I have shown in explaining the principles of justice in the Preface to my *Diplomatic Codex on the Right of Nations*. So the happiness of someone else often becomes a part of our own. We shall find that virtue, or the habit of acting reasonably, is that which achieves the most that one could promise himself—a lasting pleasure.

I most heartily applaud what is said on pages 123 ff., where it is shown that true honor [*honnêteté*] does not depend essentially upon the opinion of others. It is true that this word has degenerated somewhat today, as have the sentiments as well; when we call a man "honorable," we mean that he has the ability to make himself esteemed, that he makes a good appearance—a "speciously proper outside" [*speciosum pelle decora*].[343] . . .

The remark is good, on pages 130-31, that the truly honorable man would not even be capable of contemplating an evil act. Mr. Bayle has said something like this, which I strongly approved in the *Theodicy*, Section 318, having pointed out (in Sec. 75) that those who said of Cato that it was impossible for him to fail to do his duty meant only to praise him the more. The less we can be tempted by vice, the more strengthened we are in virtue. But there remains the important question of which of the two is better, whether to be irresolute or to be confirmed in vice. Our illustrious author seems to agree with this passage in Horace, Book ii, satire 7:

> Quanto constantior idem
> In vitiis, tanto levius miser, ac prior illo
> Qui iam contento, jam laxo fune laborat.[344]

One suffers less, in fact, when a resolution has been taken than when one is in a state of embarrassing irresolution. The authors of the philosophical sin have gone still further, for, according to them, those who sin with less remorse are more innocent. But Aristotle is for the half-wicked, whom he calls incontinent, and it can be said that their disease is more curable. The completely vicious are like people with gangrene who do not feel their illness.

The unsatisfactory reasoning of certain modern philosophers leads him to say, on page 132, that, as things stand today, honor and good morals do not appear to gain much from philosophy and profound speculation and that we should turn to common sense. He adds that usually men's first judgments on these matters are worth more than their reflections and afterthoughts. This may be true when one reasons according to the principles of Mr. Hobbes and perhaps even of Mr. Locke. But I should be sorry if it were true according to the true philosophy, which I flatter myself I have outlined in my Theodicy.

I find myself surprised by the abundance of excellent things which I discover in the Soliloquy and by the beautiful turn which is given them. What he says there about destiny paralleling liberty and about the sciences of the Romans (pp. 219-20) seems to me very important. It is to be hoped that Great Britain will maintain the glorious title given her with so much justice on page 223.[345] But, above all, literature is under obligation to our illustrious author for the recommendation with which he honors it in relation to great men (p. 224), and these will also benefit if they show a regard for that recommendation.

I doubt that the sublime style is the easiest to achieve, as he seems to say on page 242. There are few who have attained it, even among the ancients, who are otherwise so successful. I do not think that this characteristic is found with much uniformity among the Latins outside of Virgil and Tacitus.

The advice is excellent which is given to authors (pp. 264, 271) not to be guided solely by the prejudices of their country and their century and to labor to correct the vulgar rather than to flatter them. But it is only authors who resemble this one himself, that is, those having a higher talent, who can profit from this advice; the general run of authors are like the man who has written a play and is quite satisfied if he sees the stalls well filled.

I believe that there is a reference on page 287 to the late Mr. van Helmont, the younger, who was a prisoner of the Inquisition at Rome and who took it into his head, in his solitude, to examine the function of the organs in pronouncing letters and thought he had found how these characters are formed. I have known this same person unusually well, and I must do him the justice of saying that he was not as ignorant in the moral field as he seems here to be represented as being. It was he who had the Lycurgas of Ottavio Pisani reprinted and who gave advice to the public on ways to abridge legal procedure. His conduct was without reproach, his actions were full of charity and disinterestedness. Except for certain chimeras which remained with him from the impressions of his youth like a hereditary illness, he was an excellent man whose conversation was very instructive to all who could benefit from it. His works reveal only that part of him which was least praiseworthy.[346]

The remark on page 293 is good—that the physiological understanding of the passions, to which Descartes was attached, is inadequate for morals, though it has its usefulness in medicine. The Stoics were wrong, perhaps, in defining the passions by general opinion as by their popular classification, but they were right in examining the opinions which contributed toward forming and maintaining these.

It is right to scorn a sterile philosophy (p. 299), but I believe that, if the author had true ideas of space, of matter, and, above all, of substance (ideas which he speaks of as quite useless but which are not so common or so well known as may be thought), he would find in them the self-knowledge which he here advises. One would also find there what he seeks on page 300, namely, a means of being certain about one's ideas and of bringing present opinions into accord with future ones. The question of whether or not there is a vacuum (p. 301) is more remote from morals, but whoever would establish the true principles even of ethics, and be demonstratively sure of them, will not disdain this question. The agreement and disagreement of ideas are not known through a simple comparison of our perceptions; we must come to an analysis. Able man that he was, Mr. Locke did not adequately recognize this.

On the knowledge of substance, and therefore of the soul, depend the notions of virtue and of justice, as well as the question asked on page 302—whether it is reasonable to risk one's life for the good of another. Our author excels here; his charms and exhortations reveal the advantages of this Calliope, this Clio, and this Urania of whom he speaks so well on pages 316 ff.

Would God that a way might be found to reconcile learning with the education of a gentleman, as he recommends on page 335, and to direct both toward virtue. If our illustrious author had many companions in quality and merit, this could soon be achieved. He is also right in condemning the love of vain and extravagant tales which prevails (p. 349) and, even more, the opinions, so unworthy of the enlightenment of our century, which represent virtue and vice as indifferent by nature (p. 352).

I come to the second volume, in which the treatise entitled An Inquiry concerning Virtue and Merit is most systematic and contains sound opinions on the nature of virtue and happiness, showing that the affections which nature has given us lead us not merely to seek our own good but also to achieve that of those related to us, and even of society in general, and that we are happy when we act according to our natural affections. It seems to me that I could reconcile this very easily with my own language and opinions. Our natural affections do indeed make up our contentment, and, the more natural we are, the more we are led to find our pleasure in the good of another. This is the basis of universal benevolence, charity, and justice. As I have said in the Preface to my Codex, cited above, justice is at bottom only charity which conforms to wisdom. It is only reluctantly, and for a greater good, that justice sometimes obligates us to do evil. Wisdom orders that this benevolence should have degrees, just as the air, though it extends all around our globe to a great height, has greater weight and density near us than it has in the higher atmospheric regions. In the same way, one can say that the charity which bears upon those who touch us most nearly should have the greater intensity and force.

This work begins with the Divinity and distinguishes elegantly among true theism, which conceives of only one perfectly good substance governing the world; polytheism, which distributes this power; demonism, which ascribes government to some evil power; and atheism, which makes everything depend on chance or on a concourse of unintelligent causes. It seems to me that he does not make enough use, throughout the work, of the Divinity which he affirms at the beginning. Yet I see that the author wished to show that even atheists are obligated to follow virtue but that it is nevertheless true that nature leads us to admit a beneficent deity, since our natural affections conform to what such a power would order. It can be said that a certain degree of moral goodness exists independently of deity but that a consideration of the providence of God and the immortality of the soul brings morality to its height, so that in the wise man moral qualities are completely realized and honor and utility become entirely identified, without any exception or evasion.

I thought I had penetrated deeply into the opinions of our illustrious author, until I came to the treatise which is unjustly called a _Rhapsody._ Then I perceived that I had been in the forechamber only and was now entirely surprised to find myself in the chamber itself or, to use a more suitable figure, in the sanctuary of the most sublime philosophy, where I was as enchanted as was his Philocles before Theocles and Palemon. The turn of the discourse, its style, the dialogue, the new Platonism, the method of arguing through questions, but, above all, the grandeur and beauty of the ideas, their luminous enthusiasm, the apostrophe to deity, ravished me and brought me to a state of ecstasy. At the end of the book I finally returned to myself and found leisure to think about it. From the first I found in it almost all of my Theodicy before it saw the light of day. The universe all of one piece, its beauty, its universal harmony, the disappearance of real evil, especially in relation to the whole, the unity of true substances, and the great unity of the supreme substance of which all other things are merely emanations and imitations are here put in the most beautiful daylight. It lacks almost nothing but my pre-established harmony, my elimination of death, and my reduction of matter or of plurality to unities or simple substances. I had expected merely to find a philosophy like Mr. Locke's but was led beyond Plato and Descartes. If I had seen this work before my Theodicy was published, I should have profited as I ought and should have borrowed its great passages. I find nothing to change but the title, which promises so little, and I am only sorry that the book does not fill an entire volume.

I wish also that these great and beautiful meditations had been postponed until the third volume, at the end of the whole collection. For I find it hard to descend from this sublime part and to enjoy at once the more commonplace reading offered in the Miscellanies which follow it and comprise the third volume. I should have received greater pleasure from this if I had known that it ought to be read earlier. But I adjusted myself gradually and by degrees put myself in a state to judge it as it deserves. I even came to see that I should have been wrong in trying to change the order of the volumes, since this last contains the supplement to the other two and gives us comments on the five treatises which preceded, thus leaving a good taste in our mouths.

I strongly approve the praise bestowed upon the Emperor Julian (p. 81), who has always seemed to me more unfortunate than evil. As for the story of the meeting between the great Attila and Pope Leo I (p. 91), there are historians worthy of faith (like Priscus and, later, Jornandes in De rebus geticis, chap. 42) who note that his fear of dying after such a visit helped greatly to turn Attila away from his purpose to go to Rome; this opinion had been spread abroad because Alaric, king of the Visigoths, had died shortly after the capture of Rome, and it was believed that the gods had punished his boldness, so great was the respect in which this capital of our world was held at that time.[347]

The discourse on taste (Miscellany 3, chap. 2) seems to me to be important. Taste as distinguished from understanding consists of confused perceptions for which one cannot give an adequate reason. It is something like an instinct. Tastes are formed by nature and by habits. To have good taste, one must practice enjoying the good things which reason and experience have already authorized. Young people need guidance in this.

He is right (p. 211) in comparing those who seek demonstrations everywhere, and are incapable of seeing anything in everyday light, to people who are called moon-blind because they can see only by moonlight. For there are many probabilities which one is obliged to follow in life. However, it is safest to satisfy such people too if possible.

Excellent things are said about the natural inclinations (pp. 214 ff.), and nothing is as plausible as the examples which are given of animals. Because of their artificial way of life, men have unfortunately largely lost their natural instinct for adjustment to the physical. Perhaps the savages surpass us in this. But we have maintained superiority in morals, and fortunately reason and feeling concur here.

Our author is a sane judge of things. Instead of being contemptuous of ancient languages, the humanities, and criticism, as are persons of thought and those of good taste [beaux esprits] as well—two nearly opposite talents which he combines—he recognizes the importance of these fields, even in relation to religion (pp. 267-68).

I shall not comment on the passages which consider the state and the church in England, of which I have not enough knowledge. But I am sure that the wise men of that nation are thinking effectively about establishing its security, which is also that of free Europe.

In conclusion, I should strongly hope that everything in these three volumes will be translated into French as were the first pieces, so that foreigners may also profit by it. There are few works in which soundness and elegance are so well combined.

66

THE PRINCIPLES OF NATURE AND OF GRACE, BASED ON REASON

1714

The popular reception of Leibniz's *Theodicy* had the effect of establishing his reputation in even wider circles than before, and much of his last philosophical writing was done for this wider audience rather than for his scholarly correspondents and the readers of scientific journals. The circumstances and motives in writing the two best known of these works, Nos. 65 and 66 (the so-called "*Monadology*"), are not clear. Both were written in Vienna in 1714. *The Principles of Nature and of Grace* was a popular introduction to his philosophy of nature and his metaphysics, written for Prince Eugene of Savoy, a copy of which was also sent, however, to Nicolas Remond and his circle in Paris; both facts are established in the correspondence with Remond in the same and the following year (G., III, 624, 629, 631, 633-34). The purpose of the *Monadology* is less clear; according to one careful study, it was begun for Remond somewhat earlier than the *Principles*, but finished later, and aimed to be a more careful clarification of Leibniz's principles for his followers.[348] In any case, though the *Monadology* is the more complete, the papers have much in common, both in what they include and in what they omit.

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[G., VI, 598-606]

1. *Substance* is a being capable of action. It is simple or com-

pound. *Simple substance* is that which has no parts. *Compound substance* is a collection of simple substances, or *monads*.[349] *Monas* is a Greek word signifying unity or that which is one. Compounds, or bodies, are pluralities, and simple substances—lives, souls, and spirits—are unities. There must of necessity be simple substances everywhere, for without simple substances there would be no compounds. As a result, the whole of nature is full of life.

2. *Monads*, having no parts, can neither be formed nor unmade. They can neither begin nor end naturally, and therefore they last as long as the universe, which will change but will not be destroyed. They cannot have shapes, for then they would have parts. It follows that one monad by itself and at a single moment cannot be distinguished from another except by its internal qualities and actions, and these can only be its *perceptions*—that is to say, the representations of the compound, or of that which is without, in the simple—and its *appetitions*—that is to say, its tendencies from one perception to another—which are the principles of change. For the simplicity of a substance does not prevent the plurality of modifications which must necessarily be found together in the same simple substance; and these modifications must consist of the variety of relations of correspondence which the substance has with things outside. In the same way there may be found, in one *center* or point, though it is perfectly simple, an infinity of angles formed by the lines which meet in it.

3. Everything is a plenum in nature. Everywhere there are simple substances actually separated from each other by their own actions, which continually change their relations. And each outstanding simple substance or monad which forms the center of a compound substance (such as an animal, for example), and is the principle of its uniqueness, is surrounded by a mass composed of an infinity of other monads which constitute the body belonging to this central monad, corresponding to the affections by which it represents, as in a kind of center, the things which are outside of it. This body is *organic* when it forms a kind of automaton or natu-

ral machine, which is a machine not only as a whole but also in its smallest observable parts. And since everything is connected because of the plenitude of the world, and each body acts on every other one more or less, depending on the distance, and is affected by its reaction, it follows that each monad is a living mirror, or a mirror endowed with an internal action, and that it represents the universe according to its point of view and is regulated as completely as is the universe itself. The perceptions in the monad arise from each other according to the laws of the appetites or of the final causes of good and of evil, which consist in observable perceptions, whether regulated or unregulated, in the same way that bodily changes and external phenomena arise from each other according to the laws of efficient causality, that is, of motions. Thus there is a perfect harmony between the perceptions of the monad and the motions of the body, pre-established from the beginning between the system of efficient causes and that of final causes. It is in this that the accord and the physical union of soul and body consist, without either one being able to change the laws of the other.

4. Together with a particular body, each monad makes a living substance.[350] Thus not only is there life everywhere, joined to members or organs, but there are also infinite degrees of it in the monads, some of which dominate more or less over others. But when the monad has organs so adjusted that by means of them the impressions which are received, and consequently also the perceptions which represent these impressions, are heightened and distinguished (as, for example, when rays of light are concentrated by means of the shape of the humors of the eye and act with greater force), then this may amount to sensation, that is to say, to a perception accompanied by memory—a perception of which there remains a kind of echo for a long time, which makes itself heard on occasion. Such a living being is called an animal, as its monad is called a soul. When this soul is raised to the level of reason, it is something more sublime and is counted among the spirits, as will be explained presently.

It is true that animals are sometimes in the condition of simple living beings, and their souls in the condition of simple monads, namely, when their perceptions are not distinct enough so that they can be remembered. This happens in a deep sleep without dreams or in a swoon. But perceptions which have become completely confused must be developed again in animals, for reasons which I shall give below in Section 12. So it is well to make a distinction between perception, which is the inner state of the monad representing external things, and *apperception*, which is consciousness or the reflective knowledge of this inner state itself and which is not given to all souls or to any soul all the time. 351 It is for lack of this distinction that the Cartesians have made the mistake of disregarding perceptions which are not themselves perceived, just as people commonly disregard imperceptible bodies. It is this too which has made these same Cartesians think that only spirits are monads and that there is no soul in beasts, still less other *principles of life*. And after having defied the everyday opinion of men too much in denying that beasts have feeling, they adjusted their views too far to popular prejudices, on the other hand, when they confused a *long stupor* coming from a great confusion of perceptions with *death* in the *rigorous* sense, in which all perception would cease. This has confirmed the poorly grounded opinion that certain souls are destroyed and has supported the pernicious view of certain so-called free-thinkers who have denied the immortality of our souls.

5. There is a connection between the perceptions of animals which has some resemblance to reason, but it is grounded only on the memory of *facts* or effects and not on the knowledge of *causes*. Thus a dog runs away from the stick with which he has been beaten, because his memory represents to him the pain which the stick had caused him. Men too, insofar as they are empiricists, that is to say, in three-fourths of their actions, act only like beasts. For example, we expect day to dawn tomorrow because we have always experienced this to be so; only the astronomer predicts it with

reason, and even his prediction will ultimately fail when the cause of daylight, which is by no means eternal, stops. But *reasoning* in the *true* sense depends on necessary or eternal truths, as are those of logic, number, and geometry, which make the connection of ideas indubitable and their conclusions infallible. Animals in which such consequences cannot be observed are called *beasts,* but those who know these necessary truths are the ones properly called *rational animals,* and their souls are called *spirits.* These souls are capable of performing acts of reflection and of considering what is called "I," "substance," "soul," "spirit"—in a word, things and truths which are immaterial. It is this which makes us capable of the sciences or of demonstrative knowledge.

6. The investigations of the moderns have taught us, and reason confirms them, that the living beings whose organs are known to us, that is, plants and animals, do not come from putrefaction or chaos, as the ancients believed, but from *preformed* seeds, and therefore from the transformation of living beings existing prior to them. There are little animals in the seeds of large animals, which assume a new vesture in conception, which they appropriate and which provides them with a method of nourishment and growth, so that they may emerge into a greater stage and propagate the large animal. It is true that the souls of human spermatic animals are not rational and become so only when conception determines them for human nature. Just as animals in general are not completely born in conception or *generation,* moreover, neither do they completely perish in what we call *death,* for it is reasonable that what has no natural beginning also has no end within the order of nature. Thus, abandoning their masks or their rags, they merely return, but to a finer stage, on which, however, they can be as sensitive and as well ordered as on the larger one. And what has been said about grosser animals takes place also in the generation and death of spermatic animals themselves, that is, they are the enlargements of other smaller spermatic animals, in proportion to which they may be considered large, for everything in nature proceeds to infinity.

Not only souls, therefore, but animals as well, cannot be generated or perish; they are only developed, enveloped, reclothed, stripped, transformed. Souls never leave the whole of their bodies and do not pass from one body to another entirely new to them. Thus there is no metempsychosis, though there is metamorphosis. Animals change, take on, and put off, only parts; in nutrition this takes place little by little and through minute, insensible particles, but continually, while in conception or in death, where much is acquired or lost all at once, it occurs suddenly and noticeably but infrequently.

7. So far we have been speaking simply as natural scientists; now we must rise to metaphysics and make use of the great, but not commonly used, principle that nothing takes place without a sufficient reason; in other words, that nothing occurs for which it would be impossible for someone who has enough knowledge of things to give a reason adequate to determine why the thing is as it is and not otherwise. This principle having been stated, the first question which we have a right to ask will be, "Why is there something rather than nothing?" For nothing is simpler and easier than something.[352] Further, assuming that things must exist, it must be possible to give a reason why they should exist as they do and not otherwise.

8. Now this sufficient reason for the existence of the universe cannot be found in the series of contingent things, that is to say, of bodies and their representations in souls. For since matter is in itself indifferent to motion or rest, and to one motion rather than to another, one cannot find in it a reason for motion and still less for some particular motion. Although the present motion in matter arises from preceding motion, and that in turn from motion which preceded it, we do not get further however far we may go, for the same question always remains. The sufficient reason, therefore, which needs no further reason, must be outside of this series of contingent things and is found in a substance which is the cause of this series or which is a necessary being bearing the reason for

its existence within itself; otherwise we should not yet have a sufficient reason with which to stop. This final reason for things is called God.

9. This simple primary substance must include eminently[353] the perfections contained in the derivative substances which are its effects. Thus it will have perfect power, knowledge, and will; that is to say, it will have omnipotence, omniscience, and sovereign goodness. And since justice, taken in its most general sense, is nothing but goodness conforming with wisdom, there is also necessarily a sovereign justice in God. The reason which has made things exist through him has also made them depend on him for their existence and operation, and they are continually receiving from him that which causes them to have some perfection. But whatever imperfection remains with them comes from the essential and original limitation of the created beings.

10. It follows from the supreme perfection of God that he has chosen the best possible plan in producing the universe, a plan which combines the greatest variety together with the greatest order; with situation, place, and time arranged in the best way possible; with the greatest effect produced by the simplest means; with the most power, the most knowledge, the greatest happiness and goodness in created things which the universe could allow. For as all possible things have a claim to existence in God's understanding in proportion to their perfections, the result of all these claims must be the most perfect actual world which is possible. Without this it would be impossible to give a reason why things have gone as they have rather than otherwise.

11. The supreme wisdom of God has made him choose especially those laws of motion which are best adjusted and most fitted to abstract or metaphysical reasons. There is conserved the same quantity of total and absolute force or of action, also the same quantity of relative force or of reaction, and, finally, the same quantity of directive force.[354] Furthermore, action is always equal to reaction, and the entire effect is always equal to its full cause.

It is surprising that no reason can be given for the laws of motion which have been discovered in our own time, and part of which I myself have discovered, by a consideration of *efficient causes* or of matter alone. For I have found that we must have recourse to *final causes* and that these laws do not depend upon the *principle of necessity*, as do the truths of logic, arithmetic, and geometry, but upon the *principle of fitness*, that is to say, upon the choice of wisdom. This is one of the most effective and obvious proofs of the existence of God for those who can probe into these matters thoroughly.

12. It follows also from the perfection of the supreme Author, not only that the order of the entire universe is the most perfect possible, but also that each living mirror which represents the universe according to its own point of view, that is, each *monad* or each substantial center, must have its perceptions and its appetites regulated in the best way compatible with all the rest. From this it also follows that souls, that is to say, the most dominant monads, or rather animals themselves, cannot fail to awake from the state of stupor into which death or some other accident may place them.

13. For everything has been regulated in things, once for all, with as much order and agreement as possible; the supreme wisdom and goodness cannot act except with perfect harmony. The present is great with the future; the future could be read in the past; the distant is expressed in the near. One could learn the beauty of the universe in each soul if one could unravel all that is rolled up in it, but that develops perceptibly only with time. But, since each distinct perception of the soul includes an infinity of confused perceptions which envelop the entire universe, the soul itself does not know the things which it perceives until it has perceptions which are distinct and heightened.[355] And it has perfection in proportion to the distinctness of its perceptions.

Each soul knows the infinite, knows everything, but confusedly. Thus when I walk along the seashore and hear the great noise of the sea, I hear the separate sounds of each wave but do not distinguish them; our confused perceptions are the result of the impressions made on us by the whole universe. It is the same with each monad. Only God has a distinct knowledge of everything, for he is the source of everything. It has been very well said that he is everywhere as a center but that his circumference is nowhere, since everything is immediately present to him without being withdrawn at all from this center.[356]

14. As for the reasonable soul or *spirit*, there is something more in it than in monads or even in simple souls. It is not only a mirror of the universe of creatures but also an image of divinity. The spirit not only has a perception of the works of God but is even capable of producing something which resembles them, though in miniature. For not to mention the wonders of dreams in which we invent, without effort but also without will, things which we should have to think a long time to discover when awake, our soul is architectonic also in its voluntary actions and in discovering the sciences according to which God has regulated things (by weight, measure, number, etc.). In its own realm and in the small world in which it is allowed to act, the soul imitates what God performs in the great world.

15. For this reason all spirits, whether of men or of higher beings [*genies*], enter by virtue of reason and the eternal truths into a kind of society with God and are members of the City of God, that is to say, the most perfect state, formed and governed by the greatest and best of monarchs. Here there is no crime without punishment, no good action without a proportionate reward, and, finally, as much virtue and happiness as is possible. And this takes place, not by a dislocation of nature, as if what God has planned for souls could disturb the laws of bodies, but by the very order of natural things itself, by virtue of the harmony pre-established from all time between the realms of nature and of grace, between God as architect and God as monarch, in such a way that nature leads to grace, and grace perfects nature by using it.

16. Thus, though reason cannot teach us the details of the great

future, these being reserved for revelation, we can be assured by this same reason that things are arranged in a way which surpasses our desires. God being also the most perfect, the happiest, and therefore the most lovable of substances, and true pure love consisting in the state which causes pleasure to be taken in the perfections and the felicity of the beloved, this love must give us the greatest pleasure of which one is capable, since God is its object.

17. And it is easy to love him as we ought if we know him as I have said. For though God is not visible to our external senses, he is nonetheless most love-worthy and gives very great pleasure. We see how much pleasure honors give to men, although they do not consist of qualities which appear to the external senses. Martyrs and fanatics, though the affection of the latter is not well ordered, show what power the pleasure of the spirit has. What is more, even the pleasures of sense are reducible to intellectual pleasures, known confusedly. Music charms us, although its beauty consists only in the agreement of numbers and in the counting, which we do not perceive but which the soul nevertheless continues to carry out, of the beats or vibrations of sounding bodies which coincide at certain intervals. The pleasures which the eye finds in proportions are of the same nature, and those caused by other senses amount to something similar, although we may not be able to explain them so distinctly.

18. It may even be said that the love of God already gives us, here and now, a foretaste of future felicity. And, although it is disinterested, by itself it constitutes our greatest good and interest, even when we do not seek these in it and when we consider only the pleasure it gives and disregard the utility it produces. For it gives us a perfect confidence in the goodness of our Author and Master, and this produces a true tranquillity of spirit, not such as the Stoics have who resolutely force themselves to be patient, but by a present contentment which itself assures us of future happiness. And, apart from the present pleasure, nothing could be more useful for the future, for the love of God also fulfils our hopes and leads us

in the way of supreme happiness, since, by virtue of the perfect order established in the universe, everything is done in the best possible way, as much for the general good as for the greatest particular good of those who are convinced of it and are satisfied by the divine government. This cannot fail to be true of those who know how to love the source of all good. It is true that the supreme happiness (with whatever *beatific vision* or knowledge of God it may be accompanied) cannot ever be full, because God, being infinite, cannot ever be known entirely. Thus our happiness will never consist, and ought never to consist, in complete joy, which leaves nothing to be desired and which would stupefy our spirit, but in a perpetual progress to new pleasures and new perfections.

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"*The Monadology*"[357]

1714

[G., VI, 607-23]

1. The *monad* which we are to discuss here is nothing but a simple substance which enters into compounds. *Simple* means without parts. (*Theodicy*, Sec. 10.)

2. There must be simple substances, since there are compounds, for the compounded is but a collection or an *aggregate* of simples.

3. But where there are no parts, it is impossible to have either extension, or figure, or divisibility. The monads are the true atoms of nature; in a word, they are the elements of things.

4. We need fear no dissolution in them, and there is no conceivable way in which a simple substance can be destroyed naturally. (*Ibid.*, Sec. 89.)

5. For the same reason there is no way in which a simple substance can have a natural beginning, since it cannot be formed by composition.

6. So one can say that monads can only begin or end all at once, that is, they cannot begin except by creation or end except by annihilation. That which is compounded, instead, begins and ends in parts.

7. There is likewise no way of explaining how a monad can be altered or changed internally by any other creature, since nothing can be transposed in it, and we cannot conceive in it, as we can in composite things among whose parts there may be changes, that any internal motion can be excited, directed, increased, or diminished from without. Monads have no windows through which any-

thing could enter or depart. Accidents cannot be detached from substances and march about outside of substances, as the sensible species of the Scholastics once did.[358] So neither substance nor attribute can enter a monad from without.

8. Yet it is necessary for monads to have some qualities; otherwise they would not even be beings. And if simple substances did not differ by their qualities, there would be no way of perceiving any change in things, since what is in the composite can come only from its simple ingredients; and monads, if they were without qualities, could not be distinguished from each other, especially since they do not differ in quantity. Consequently, assuming a plenum, each place would always receive in any motion the equivalent of what it had already had, and one state of things could not be distinguished from another.

9. It is even necessary for each monad to be different from every other. For there are never two things in nature which are perfectly alike and in which it is impossible to find a difference that is internal or founded on an intrinsic denomination.[359]

10. I also take it as agreed that every created being is subject to change, and therefore the created monad also, and further that this change is continuous in each one.

11. It follows from what I have said that the natural changes in monads come from an *internal principle*, since an external cause could not influence [*influer dans*] their interior. (*Ibid.*, Secs. 396 and 400.)

12. But besides the principle of change there must be some distinguishing *detail in that which changes*, which constitutes the specific nature and the variety, so to speak, of simple substances.[360]

13. This detail must enfold a multitude in the unity or the simple. For every natural change takes place by degrees—something changes and something remains—and as a result there must be a plurality of affections and of relations in the simple substance, even though it has no parts.

14. The passing state which enfolds and represents a multitude

in unity or in the simple substance is merely what is called *perception.* This must be distinguished from apperception or from consciousness, as what follows will make clear. It is in this that the Cartesians made a great mistake, for they disregarded perceptions which are not perceived. It is this, too, which led them to believe that only spirits are monads and that there are no souls in beasts or other entelechies. It led them into the popular confusion of a long stupor with death in a rigorous sense, which made them support the Scholastic prejudice that souls are entirely separate, and even confirmed some ill-balanced minds in a belief in the mortality of the soul.

15. The action of the internal principle which brings about change or the passage from one perception to another can be called *appetition.* It is true that appetite need not always fully attain the whole perception to which it tends, but it always attains some of it and reaches new perceptions.

16. We ourselves experience a multitude in a simple substance when we find that the slightest thought which we perceive enfolds a variety in its object. Hence everyone who recognizes that the soul is a simple substance should also recognize this multitude in the monad, and Mr. Bayle ought not to find the difficulty in it which he does in his *Dictionary,* in the article on Rorarius.[361]

17. It must be confessed, moreover, that perception and what depends on it are *inexplicable by mechanical reasons,* that is, by figures and motions. If we pretend that there is a machine whose structure enables it to think, feel, and have perception, one could think of it as enlarged yet preserving its same proportions, so that one could enter it as one does a mill. If we did this, we should find nothing within but parts which push upon each other; we should never see anything which would explain a perception. So it is in the simple substance, and not in the composite substance or machine, that perception must be sought. Furthermore, this is the only thing—namely, perceptions and their changes—that can be found in simple substance. It is in this alone that the *internal actions* of simple substances can consist. (*Ibid.*, Preface.)[362]

18. All simple substances or created monads might be given the name of *entelechies*, for they have in them a certain perfection (ἔχουσι τὸ ἐντελές). There is in them a certain sufficiency (αὐτάρκεια) which makes them the sources of their internal actions and, so to speak, incorporeal automata. (*Ibid.*, Sec. 87.)

19. If we wish to designate by soul everything which has perceptions and appetites in the general sense which I have just explained, all simple substances or created monads could be called souls. But since feeling is something more than a simple perception, I agree that the general name of monads or entelechies is enough for simple substances which have only perception and that only those should be called souls in which perception is more distinct and accompanied by memory.[363]

20. For we experience within ourselves a state in which we remember nothing and have no distinguishable perception, as when we fall into a swoon or are overcome by a deep and dreamless sleep. In this condition the soul does not differ sensibly from a simple monad. But since this condition does not last, and the soul emerges from it, the soul is something more. (*Ibid.*, Sec. 64.)

21. It does not follow that during this state the simple substance is without any perception. For the reasons already given, that is not even possible, for it cannot perish and it cannot subsist without some affection, which is nothing but its perception. But when there is a large multitude of small perceptions with nothing to distinguish them, we are stupefied, as when we turn continuously in the same direction several times, so that a dizziness overcomes us and we grow faint and can distinguish nothing. Death can produce this state in animals for a time.

22. Since every present state of a simple substance is a natural consequence of its preceding state, in such a way that the present is great with the future (*ibid.*, Sec. 360),

23. and since we perceive our perceptions when awaking from a stupor, it follows necessarily that we have had these perceptions immediately before, even though we did not then perceive them,

for a perception can come naturally only from another perception, just as one motion can come naturally only from another motion (*ibid.*, Secs. 401-3).

24. From this we can see that if we had nothing distinctive in our perceptions, and nothing lifted out, so to speak, and of a higher flavor, we should always be in a state of stupor. This is the state of the naked monads.

25. We see too that nature has given heightened perceptions to animals by the care she has taken to provide them with organs which gather numerous light rays, or many air waves, so as to give them greater effectiveness through their union. There is something approaching this in smell, taste, and touch and perhaps in many other senses which we do not know. I will explain presently how what occurs in the soul represents what happens in the organs.

26. Memory provides a kind of *consecutiveness* to souls which simulates reason but which must be distinguished from it. Thus we see that, when animals have a perception of something which strikes them and of which they have had a similar perception previously, they are led by the representation of their memory to expect whatever was connected with it in this earlier perception and so come to have feelings like those which they had before. When one shows a stick to dogs, for example, they remember the pain it has caused them and whine or run away. (*Ibid.*, Prelim., Sec. 65.)

27. The strong imagination which strikes and moves them comes either from the magnitude or from the number of the perceptions which preceded it. For often one single strong impression produces at once the effect of a long-formed *habit* or of many frequently repeated ordinary perceptions.

28. Men act like beasts insofar as the sequences of their perceptions are based only on the principle of memory, like empirical physicians who have a simple practice without theory. We are all mere empirics in three-fourths of our actions. For example, when we expect daylight tomorrow, we act as empiricists, because this has always happened up to the present. Only an astronomer concludes it by reason.

29. But it is the knowledge of necessary and eternal truths which distinguishes us from simple animals and gives us *reason* and the sciences, lifting us to the knowledge of ourselves and of God. It is this within us which we call the rational soul or *spirit*.

30. It is also by the knowledge of necessary truths and by their abstractions that we rise to *reflective acts*, which enable us to think of what is called *I* and to consider this or that to be in us; it is thus, as we think of ourselves, that we think of being, of substance, whether simple or compound, of the immaterial, and of God himself, conceiving of that which is limited in us as being without limits in him. These reflective acts provide us with the principal objects of our reasonings (*ibid.*, Preface, 4*a*).

31. Our reasonings are based upon two great principles: the first the *principle of contradiction*, by virtue of which we judge that false which involves a contradiction, and that *true* which is opposed or contradictory to the false (*ibid.*, Secs. 44 and 196);

32. and the second the *principle of sufficient reason*, by virtue of which we observe that there can be found no fact that is true or existent, or any true proposition, without there being a sufficient reason for its being so and not otherwise, although we cannot know these reasons in most cases (*ibid.*, Secs. 44 and 196).

33. There are also two kinds of truths, truths of *reasoning* and truths of *fact*. Truths of reasoning are necessary, and their opposite is impossible. Truths of fact are contingent, and their opposite is possible. When a truth is necessary, the reason for it can be found by analysis, resolving it into more simple ideas and truths until we reach the primitive (*ibid.*, Secs. 170, 174, 189, 280-82, and 367; Abr. obj. 3).

34. It is thus that speculative *theorems* and *rules* of practice in mathematics are reduced by analysis to *definitions, axioms*, and *postulates*.

35. There are, finally, *simple ideas* which cannot be defined, and there are also axioms and postulates, or, in brief, *primitive principles*, which cannot be proved and need no proof. And these

are identical propositions whose opposites contain an explicit contradiction.

36. But a sufficient reason must also be found in contingent truths or truths of fact, that is to say, in the sequence of things distributed through the universe of creatures, whose analysis into particular reasons could proceed into unlimited detail because of the immense variety of things in nature and the division of bodies into the infinite. There is an infinity of shapes and motions, present and past, which enter into the efficient cause of my present writing, and there is an infinity of small inclinations and dispositions of my soul, present and past, which enter into its final cause. (Ibid., Secs. 36, 37, 44, 45, 49, 52, 121, 122, 337, 340, and 344.)

37. As all this detail includes other earlier or more detailed contingent factors, each of which in turn needs a similar analysis to give its reason, one makes no progress, and the sufficient or final reason will have to be outside the sequence or series of these detailed contingent factors, however infinite they may be.

38. Thus the final reason of things must be in a necessary substance in which the detail of the changes can be contained only eminently, as in their source. It is this substance that we call God. (Ibid., Sec. 7.)

39. Now since this substance is a sufficient reason for all this detail, and the detail is interconnected throughout, there is only one God, and this God is enough.

40. We may conclude, too, that this supreme substance, being unique, universal, and necessary, and having nothing outside of it which is independent of it, and being a simple consequence of possible being, must be incapable of limits and must contain as much reality as is possible.

41. It follows from this that God is absolutely perfect; perfection being nothing but the quantity of positive reality taken strictly, when we put aside the limits or bounds in the things which are limited. But where there are no bounds, that is, in God, perfection is absolutely infinite. (Ibid., Sec. 22; Preface, 4a.)

42. It also follows that creatures receive their perfections from the influence of God but that their imperfections are due to their own nature, which is incapable of being limitless. For it is in this that they differ from God. (*Ibid.*, Secs. 20, 27-31, 153, 167, and 377 ff.) This *original imperfection* of creatures is noticeable in the *natural inertia* of the body. (*Ibid.*, Secs. 30 and 380; Abr. obj. 5.)[364]

43. It is also true that the source not only of existences but also of essences is in God, insofar as these essences are real or insofar as there is something real in possibility. This is because the understanding of God is the region of eternal truths or of the ideas upon which they depend and because without him there would be no reality in possibilities—not only nothing existent but also nothing possible. (*Ibid.*, Sec. 20.)

44. For if there is a reality in the essences or possibilities, or in the eternal truths as well, this reality must be founded on something existent and actual, and therefore in the existence of a necessary being, in whom essence includes existence or in whom it is enough to be possible in order to be actual. (*Ibid.*, Secs. 184, 189, and 335.)

45. Thus God alone, or the necessary being, has the privilege of necessarily existing if he is possible. And since nothing can prevent the possibility of that which is without any limits, without any negation, and consequently without any contradiction, this fact alone suffices to know the existence of God a priori. So we have proved it through the reality of eternal truths.[365] But we have also proved it a posteriori, since contingent beings exist, and their final or sufficient reason can be discovered only in a necessary being which has its reason for its existence in itself.

46. We must not imagine as do some, however, that, since the eternal truths are dependent upon God, they are arbitrary and dependent on his will, as Descartes and later Mr. Poiret seem to have held.[366] This is true only of contingent truths, whose principle is *fitness* or the choice of the *best*; necessary truths, how-

ever, depend solely on his understanding and are its internal object. (*Ibid.*, Secs. 180, 184, 185, 335, 351, and 380.)

47. So only God is the primary unity or the simple original substance of which all the created or derivative monads are products, and from whom they are born, so to speak, by continual fulgurations of the divinity from moment to moment, but limited by the receptivity of the created being, for whom it is essential to have limits. (*Ibid.*, Secs. 382–91, 398, and 395.)

48. There is in God the *power* which is the source of everything, there is also the *knowledge* which contains the variety of the ideas, and, finally, there is the *will* which makes changes or products in accordance with the principle of the best. This corresponds to what is in created monads the subject or basis, the perceptive faculty, and the appetitive faculty. But in God these attributes are absolutely infinite or perfect, and in created monads or entelechies—or *perfectihabies*, as Hermolaus Barbarus translated this word—they are nothing but imitations in the degree to which the monad has perfection. (*Ibid.*, Secs. 7, 149, 150, and 87.)

49. The created being is said to *act* outwardly insofar as it has perfection and to *suffer* from another insofar as it is imperfect. Thus *action* is attributed to a monad insofar as it has distinct perceptions, and *passion* insofar as it has confused ones. (*Ibid.*, Secs. 32, 66, and 386.)

50. One created being is more perfect than another if one finds in it that which will supply a reason a priori for what happens in the other. And it is because of this that it is said to act upon the other.

51. But in simple substances there is only an *ideal* influence of one monad upon another. This can have its effect only by the intervention of God, insofar as one monad may with reason demand, in the ideas of God, that God should have a concern for it in regulating the rest from the beginning of things. For since a created monad can have no physical influence on the interior of another, it is only in this way that one can be dependent on the other. (*Ibid.*, Secs. 9, 54, 65, 66, and 201; Abr. obj. 3.)

52. It is in this way that actions and passions are mutual among creatures. For God, comparing two simple substances, finds the reasons in each which oblige him to adapt the other to it, with the result that whatever is active in certain respects is passive considered from another point—*active* insofar as what we distinctly know in it serves as a reason for what happens in another, but *passive* insofar as the reason for what happens in it is found in what we know distinctly in another. (*Ibid.*, Sec. 66.)

53. Now since there is an infinity of possible universes in the ideas of God, but only one can exist, there must be a sufficient reason for God's choice which determines him to one rather than another. (*Ibid.*, Secs. 8, 10, 44, 173, 196-97, 225, and 414-16.)

54. This reason can be found only in the *fitness* or in the degrees of perfection which these worlds contain, each possible one having a right to claim existence in the measure of the perfection which it enfolds. (*Ibid.*, Secs. 74, 167, 350, 201, 130, 352, 345-46, and 354.)

55. And this is the cause for the existence of the best, which his wisdom causes God to know, his goodness makes him choose, and his power makes him produce. (*Ibid.*, Secs. 8, 78, 80, 84, 119, 204, 206, and 208; Abr. obj. 1, 8.)

56. Now this mutual connection or accommodation of all created things to each other and of each to all the rest causes each simple substance to have relations which express all the others and consequently to be a perpetual living mirror of the universe. (*Ibid.*, Secs. 130 and 360.)

57. Just as the same city viewed from different sides appears to be different and to be, as it were, multiplied in perspectives, so the infinite multitude of simple substances, which seem to be so many different universes, are nevertheless only the perspectives of a single universe according to the different points of view of each monad. (*Ibid.*, Sec. 147.)

58. This is the means of obtaining the greatest variety possible, but with the greatest possible order; that is to say, this is the means of attaining as much perfection as possible. (*Ibid.*, Secs. 120, 124, 241-42, 215, 243, and 275.)

59. It is only this hypothesis, moreover, which I dare say is demonstrated, that exalts the greatness of God as one ought. Mr. Bayle recognized this when he raised objections to it in his Dictionary (article Rorarius), where he was even inclined to believe that I ascribed too much to God, more than is possible. Yet he was unable to set forth any reason why this universal harmony, which results in every substance expressing exactly all the others by means of the relations which it has with them, should be impossible.

60. From what I have been saying, furthermore, we may see the a priori reasons why things could not be otherwise than they are. This is because God has had regard for each part in regulating the whole and in particular for each monad. The nature of the monad being to represent, nothing can keep it from representing only a part of things, though it is true that its representation is merely confused as to the details of the whole universe and can be distinct for a small part of things only, that is, for those which are the nearest or the greatest in relation to each individual monad.[367] Otherwise each monad would be a divinity. It is not in the object but in the modification of their knowledge of the object that the monads are limited. They all move confusedly toward the infinite, toward the whole, but they are limited and distinguished from each other by the degrees of their distinct perceptions.

61. In this respect compound beings are in symbolic agreement with the simple. For everything is a plenum, so that all matter is bound together, and every motion in this plenum has some effect upon distant bodies in proportion to their distance, in such a way that every body not only is affected by those which touch it and somehow feels whatever happens to them but is also, by means of them, sensitive to others which adjoin those by which it is immediately touched. It follows that this communication extends to any distance whatever. As a result, every body responds to everything which happens in the universe, so that he who sees all could

read in each everything that happens everywhere, and, indeed, even what has happened and will happen, observing in the present all that is removed from it, whether in space or in time. "All things are conspirant," as Hippocrates said.[368] But a soul can read within itself only what it represents distinctly; it cannot all at once develop all that is enfolded within it, for this reaches to infinity.

62. Thus, although each created monad represents the whole universe, it represents more distinctly the body which is particularly affected by it and of which it is the entelechy. And, as this body expresses the whole universe by the connection between all matter in the plenum, the soul also represents the whole universe in representing the body which belongs to it in a particular way. (Ibid., Sec. 400.)

63. The body belonging to a monad which is its entelechy or soul constitutes what may be called a living being with that entelechy; with a soul it constitutes an animal. Now the body of a living being or an animal is always organic, for, since every monad is a mirror of the universe in its own way, and the universe is regulated in perfect order, there must also be an order in the being which represents it, that is to say, in the perceptions of the soul and therefore also in the body, according to which the universe is represented in it. (Ibid., Sec. 403.)

64. So each organic body belonging to a living being is a kind of divine machine or natural automaton infinitely surpassing all artificial automata. For a machine made by human art is not a machine in each of its parts; for example, the tooth of a brass wheel has parts or fragments which are not artificial so far as we are concerned, and which do not have the character of a machine, in that they fit the use for which the wheel was intended. But the machines of nature, living bodies, are still machines in their smallest parts, into infinity. It is this that makes the difference between nature and art, that is, between the divine art and ours. (Ibid., Secs. 134, 146, 194, and 403.)[369]

65. And the author of nature has been able to practice this divine and infinitely wonderful artisanship because each part of matter not only is infinitely divisible, as the ancients recognized, but also is actually subdivided without end, each part into parts, each of which has its own distinct movement. Otherwise it would be impossible that each part of matter could express the whole universe. (*Ibid.*, Prelim., Sec. 70; Sec. 195.)

66. It is clear from this that there is a world of creatures, living beings, animals, entelechies, souls, in the smallest particle of matter.

67. Each part of matter can be thought of as a garden full of plants or as a pond full of fish. But each branch of the plant, each member of the animal, each drop of its humors, is also such a garden or such a pond.

68. And although the earth and the air interspersed between the plants of the garden, and the water interspersed between the fish in the pond, are not themselves plants or fish, they also contain them, though most frequently of a fineness imperceptible to us.

69. Thus there is nothing fallow, sterile, or dead in the universe; no chaos, no confusions, save in appearance. This would be comparable, perhaps, to a pond seen from a distance, in which we should see the confused swarming movements of the fish, so to speak, without seeing the fish themselves. (*Ibid.*, Preface, 5b-6.)[370]

70. Hence we see that each living body has a dominant entelechy which is the soul in the case of an animal; but the members of this living body are full of other living beings, plants, and animals, each one of which also has its dominant entelechy or soul.

71. But we must not imagine, as some have done who have misunderstood my thought, that each soul has its own mass or quantity of matter belonging to it or affected by it forever, and that it consequently possesses other inferior living beings forever destined to serve it. For all bodies are in a perpetual flux, like rivers, and parts are passing in and out from them continually.

72. Thus the soul only changes its body little by little and by

degrees, so that it is never deprived of all its organs at once; there is often metamorphosis in animals but never metempsychosis or transmigration of souls. Neither are there entirely separated souls or higher spirits [genies] without bodies. God alone is entirely detached from body. (Ibid., Secs. 90 and 124.)

73. It is because of this, too, that there is never complete generation or, strictly speaking, perfect death, consisting in the separation of the soul. What we call generation is a development and an increase, just as what we call death is an envelopment and a diminution.

74. Philosophers have been greatly embarrassed over the origin of forms, entelechies, or souls. Today, however, when exact investigations made on plants, insects, and animals have shown that the organic bodies of nature are never produced from chaos or from putrefaction, but always through seeds in which there is undoubtedly some preformation, it has been concluded not only that the organic body was already there before conception but also that there was a soul in this body and, in a word, that the animal itself was there, so that conception is merely the means by which the animal is prepared for a great transformation by which it becomes an animal of another kind. Something approaching this may even be seen apart from generation, as when worms become flies and caterpillars become butterflies. (Ibid., Secs. 86, 89; Preface; Secs. 90, 187, 188, 403, 86, and 397.)

75. The animals, some of which are raised by means of conception to the level of greater animals, can be called spermatic. But those among them which remain in their own kind—and this is most of them—are born, multiply, and perish like large animals; there is only a small number of chosen ones which pass into a greater theater.

76. This is but half of the truth, however. So I have concluded that, if an animal never has a beginning naturally, neither does it end naturally, and that there will be not only no generation but also, rigorously speaking, no total destruction or death. And this a pos-

teriori reasoning, drawn from experience, agrees perfectly with the principles which I have deduced a priori above. (*Ibid.*, Sec. 90.)

77. So it can be said that not only the soul, as mirror of an indestructible universe, is itself indestructible but also the animal itself, although its machine may often perish in part and cast off or take on particular organic coverings.

78. These principles have given me a method for explaining naturally the union or, better, the conformity of the soul and the organic body. The soul follows its own laws, and the body its own likewise, and they agree with each other by virtue of the harmony pre-established between all substances, since they are all representations of one and the same universe. (*Ibid.*, Preface; Secs. 340, 352, 353, and 358.)

79. Souls act according to the laws of final causes through their appetitions, ends, and means. Bodies act according to the laws of efficient causes or the laws of motion. And the two kingdoms, that of efficient and that of final causes, are in harmony with each other.

80. Descartes recognized that souls cannot give force to bodies because the same quantity of force is always conserved in matter. He believed, however, that the soul could change the direction of the body. But this was because the law of nature was still unknown in his day, according to which matter conserves also the same total direction. If he had noticed this, he would have fallen upon my system of pre-established harmony. (*Ibid.*, Preface; Secs. 22, 59, 60, 61, 63, 66, 346-47, 354, and 355.)

81. In this system bodies act as if there were no souls (to assume an impossibility), and souls act as if there were no bodies, and both act as if each influenced the other.

82. As for *spirits* or rational souls, although I find that what I have just been saying is true at bottom of all living beings and animals (that is, that the soul and the animal begin only with the world and come to an end only with the world), yet there is this peculiar

thing about rational animals, that their little spermatic animals, as long as they are only this, have only ordinary or sensitive souls, but as soon as the elect among these, so to speak, arrive at human nature through actual conception, their sensitive souls are raised to the level of reason and to the prerogative of spirits. (Ibid., Secs. 91 and 397.)

83. Among other differences which exist between ordinary souls and spirits, some of which I have already pointed out, there is still this: souls in general are living mirrors or images of the universe of created beings, while spirits are also images of divinity itself or of the author of nature, capable of knowing the system of the universe and of imitating it to some extent by means of architectonic samples, each spirit being like a little divinity within its own sphere. (Ibid., Sec. 147.)

84. It is this which renders spirits capable of entering into a kind of society with God and makes his relation to them not merely that of an inventor to his machine (as God is related to other creatures) but also that of a prince to his subjects and even a father to his children.

85. It is easy to conclude from this that the assemblage of all spirits must make up the city of God, that is to say, the most perfect state which is possible under the most perfect of monarchs. (Ibid., Sec. 146; Abr. obj. 2.)

86. This city of God, this truly universal monarchy, is a moral world within the natural world and is the most exalted and the most divine of all of God's works. In it the true glory of God consists, for he would have no glory if his greatness and goodness were not known and admired by spirits. It is also in relation to this divine city that his distinctive goodness is found, whereas his wisdom and power are shown everywhere.

87. As we have established above a perfect harmony between two natural kingdoms, that of efficient and that of final causes, we must also point out here another harmony between the physical kingdom of nature and the moral kingdom of grace, that is to say, be-

tween God considered as architect of the machine of the universe and God considered as monarch of the divine city of spirits. (*Ibid.*, Secs. 62, 74, 118, 248, 112, 130, and 247.)

88. The result of this harmony is that things lead to grace by means of the very ways of nature and that this globe, for example, must be destroyed and repaired by natural ways at those times which the government of spirits demands for the punishment of some and the reward of others. (*Ibid.*, Secs. 18-19, 110, 244, 245, and 340.)

89. It can also be said that God as architect satisfies God as lawgiver in everything and that sins must therefore carry their punishment with them by the order of nature, and even by virtue of the mechanical structure of things; and that noble actions, similarly, attain their rewards through ways that are mechanical in relation to bodies, although this cannot and should not always happen at once.

90. Finally, under this most perfect government there will be no good action without reward and no evil action without punishment, and everything must turn out for the well-being of those who are good, that is to say, those who are not dissatisfied in this great state, who trust in providence after they have done their own duty, who love and imitate the Author of all good as they ought, taking pleasure in the contemplation of his perfections after the nature of the true *pure love,*[371] which makes us find our pleasure in the happiness of the beloved. This it is which makes the wise and virtuous work for all that seems to conform to the divine will, presumptive or antecedent, and yet content themselves with what God causes to happen to them by his will, secret, consequent, and decisive;[372] recognizing as they do that, if we could sufficiently understand the order of the universe, we should find that it surpasses the desires of the most wise and that it is impossible to make it better than it is, not only for the whole in general, but also for ourselves in particular, if we are attached as we should be to the Author of the whole, not only as to the architect and efficient cause of our being,

but also as to our master and final cause, who must be the whole end of our will and can alone make our happiness. (Ibid., Sec. 134 end; Preface, 4; Sec. 278.)

68

Letters to Nicolas Remond

1714-15

Nicolas Remond, chief counselor of the Duke of Orleans and brother of the mathematician Remond de Monmort, was a courtier of wide interests and attainments, whose correspondence with Leibniz, opened through the mediation of Pierre Coste in 1713, constitutes a critical and philosophical miscellany of considerable interest for the closing years of Leibniz's life. He seems to have looked to Remond in Paris, as to Eugene of Savoy in Vienna, for the propagation of his ideas in the circles of the powerful and influential. The correspondence begins with Remond's account of his interest in Plato.

* * *

I

[G., III, 605-7]

Vienna, January 10, 1714

. . . I find it natural that you have enjoyed some of my thoughts after having penetrated into Plato's, an author who has meant much to me and who deserves to be systematized. I believe that I can carry out the demonstration of truths which he has merely advanced. Having followed his steps and those of certain other great men, I flatter myself to have profited by them and to have penetrated, at least to a point, the bright temples of wisdom:

Edita doctrina, sapientum templa serena.[373]

This relates to general truths which do not depend upon facts but which are nonetheless, in my opinion, the key to the knowledge which judges facts.

I should venture to add that if I had been less distracted, or if I were younger or had talented young men to help me, I should still hope to create a kind of universal symbolistic [spécieuse générale] in which all truths of reason would be reduced to a kind of calculus. At the same time this could be a kind of universal language or writing, though infinitely different from all such languages which have thus far been proposed, for the characters and the words themselves would give directions to reason, and the errors—except those of fact—would be only mistakes in calculation. It would be very difficult to form or invent this language or characteristic but very easy to learn it without any dictionaries. When we lack sufficient data to arrive at certainty in our truths, it would also serve to estimate degrees of probability and to see what is needed to provide this certainty. Such an estimate would be most important for the problems of life and for practical considerations, where our errors in estimating probabilities often amount to more than a half. . . .

. . . Besides always taking care to direct my study toward edification, I have tried to uncover and unite the truth buried and scattered under the opinions of all the different philosophical sects, and I believe I have added something of my own which takes a few steps forward. The circumstances under which my studies proceeded from my earliest youth have given me some facility in this. I discovered Aristotle as a lad, and even the Scholastics did not repel me; even now I do not regret this. But then Plato too, and Plotinus, gave me some satisfaction, not to mention other ancient thinkers whom I consulted later. After having finished the trivial schools,[374] I fell upon the moderns, and I recall walking in a grove on the outskirts of Leipzig called the Rosental, at the age of fifteen, and deliberating whether to preserve substantial forms or not. Mechanism finally prevailed and led me to apply myself to mathematics.

It is true that I did not penetrate into its depths until after some conversations with Mr. Huygens in Paris. But when I looked for the ultimate reasons for mechanism, and even for the laws of motion, I was greatly surprised to see that they could not be found in mathematics but that I should have to return to metaphysics. This led me back to entelechies, and from the material to the formal, and at last brought me to understand, after many corrections and forward steps in my thinking, that monads or simple substances are the only true substances and that material things are only phenomena, though well founded and well connected. Of this, Plato, and even the later Academics and the skeptics too, had caught some glimpses, but these successors of Plato did not make as good use of it as did he himself.

I have found that most of the sects are right in a good part of what they propose, but not so much in what they deny. The formalists, Platonists and Aristotelians, for example, are right in seeking the source of things in final and formal causes. But they are wrong in neglecting efficient and material causes and in inferring from this, as did Henry More in England and certain other Platonists, that there are phenomena which cannot be explained mechanically. The materialists, on the other hand, or those who accept only a mechanical philosophy, are wrong in rejecting metaphysical considerations and trying to explain everything in terms of sense experience.

I flatter myself to have penetrated into the harmony of these different realms and to have seen that both sides are right provided that they do not clash with each other; that everything in nature happens mechanically and at the same time metaphysically but that the source of mechanics is in metaphysics. It was not easy to uncover this mystery, because there are few men who take the pains to combine both types of study.

Descartes did it, but not thoroughly enough. He went too fast in setting up most of his doctrines; one may say that his philosophy is the entrance hall to the truth. What held him back most was that he did not know the true laws of mechanics or of motion; these could have put him back on the track. Mr. Huygens was the first to see them, though imperfectly, but he had no taste for metaphysics, any more than did other capable men who have followed him in investigating this subject. I have observed in my book that, if Descartes had seen that nature conserves not only the same force but also the same total direction in the laws of motion, he would not have held that the soul can change the direction of the body more easily than its force, and he would have gone straightway to the system of *pre-established harmony*, which is a necessary conclusion from the conservation of both force and direction.[375] . . .

II

[G., III, 611-13]

Vienna, March 14, 1714

. . . If I have succeeded in arousing men of excellence to cultivate the infinitesimal calculus, this is because I have been able to give some important examples of its usefulness. When I first told Mr. Huygens something about it in my letters, he scorned it; he did not think there was anything mysterious in it until he saw its surprising applications, which led him to study it just before his death—this man whose pre-eminent merit almost gave him the right to distrust everything which he himself did not know. I have spoken to the Marquis de l'Hospital and others about my universal symbolistic, but they have paid no more attention to it than if I had told them about a dream I had dreamed. I should have to support it too by some obvious application, but to achieve this it would be necessary to work out at least a part of my characteristic—a task which is not easy, especially in my present condition and without the advantage of discussions with men who could stimulate me and help me in work of this nature.

The source of our difficulties with the composition of the continuum comes from the fact that we think of matter and space as substances, whereas in themselves material things are merely well-regulated phenomena, and space is exactly the same as the order of coexistence, as time is the order of existence which is not simultaneous.[376] Insofar as they are not designated in extension by factual phenomena, parts consist only in possibility; there are no parts in a line except as there are fractions in unity. But if we assume that all possible points actually exist in the whole—as we should have to say if this whole were a substantial thing composed of all its parts—we should be lost in an inextricable labyrinth.

I once said something about this to Mr. Hugony, who writes me that he has the honor of your acquaintance. He has also seen my rather extensive thoughts on Locke's work on the human understanding. I have a repugnance against publishing refutations of dead authors, however, for such refutations should appear during their lives and be sent to the authors themselves. Some slight comments escaped me, I do not know how, and were carried to England by a relative of the late Mr. Burnet, Bishop of Salisbury. Mr. Locke saw them and spoke of them with disdain in a letter to Mr. Molyneux, which is found with others in Locke's posthumous letters. I did not know of his opinion until after this letter was published, but I am not surprised, for our principles differed a little too widely, and those which I advanced must have seemed paradoxical to him. But a friend who is inclined to favor me rather than Locke tells me that what was inserted of my reflections seemed to him the best in the collection.[377] Since I have not seen it, I cannot confirm his judgment. Mr. Locke had subtlety and skill and a kind of superficial metaphysics for which he was able to secure acclaim, but he was ignorant of the mathematical method.

It is too bad that Pascal, a mind at once outstanding in mathematics and metaphysics, grew weak too soon, as Mr. Huygens once told me, because of too persistent labors and too much preoccupation with theological works with which he might have secured the applause of a large party if he had been able to finish them. He even gave himself up to austerities which could not have helped profound thinking, and even less his health. His nephew, Mr. Perier, once gave me an excellent work by his uncle on conic sections to read and arrange; I hoped that it would be published at once. It would have conserved for him the honor of originality in matters which deserve such pains. . . .

III

[G., III, 618-21]

Vienna, July, 1714

. . . It is true that my Theodicy does not suffice to present my system as a whole. But if it is joined with what I have published in various journals, those of Leipzig, Paris, and those of Mr. Bayle and Mr. Basnage, it will not fall far short of doing so, at least for the principles. . . .

Mr. Wolff has adopted some of my opinions, but since he is very busy with teaching, especially in mathematics, and we have not had much correspondence together on philosophy, he can know very little about my opinions beyond those which I have published. I have seen some of the things which young men have written under him; I found much that is good in them, yet there were points with which I did not agree. So if he has written something on the soul, whether in German or some other language, I shall try to see it and tell you about it. . . .

When I was young, I found some pleasure in the Lullian art, yet I thought also that I found some defects in it, and I said something about these in a little schoolboyish essay called On the Art of Combinations, published in 1666, and later reprinted without my permission. But I do not readily disdain anything—except the arts of divination, which are nothing but pure cheating—and I have found something valuable, too, in the art of Lully and in the *Digestum sapientiae* of the Capuchin, Father Ives, which pleased me greatly because he found a way to apply Lully's generalities to useful particular problems. But it seems to me that Descartes had a profundity of an entirely different level. In spite of the advancement which much of our knowledge has received from it, however, his philosophy also has its defects, of which you cannot be unaware by this time.

As for Gassendi, of whom you ask my opinion, I find that he has great and wide knowledge and is well versed in his reading of the ancients and in both secular and ecclesiastical history and all classes of learning. But his thoughts satisfy me less now than they did when I first began to drop Scholastic views in my own schoolboy days. Since the atomic theory satisfies the perceptual imagination, I gave myself to it, and it seemed to me that the void of Democritus or Epicurus, together with their incorruptible atoms, would remove all difficulties. It is true that this hypothesis can satisfy mere physical scientists, and, assuming that there are such atoms and giving them suitable motions and figures, there are few material qualities which they could not explain if we knew enough of the details of things. So the philosophy of Gassendi could be used to introduce young students to the knowledge of nature, if they were told that the void and the atoms were used merely as a hypothesis and that they might someday fill this void with a fluid so subtle that it could hardly affect phenomena and also that the permanent rigidity of the atoms must not be taken too rigorously.

Having pushed my own thinking further, however, I have found that the void and the atoms cannot subsist at all. Some letters which I exchanged with Mr. Hartsoeker have been published in the *Mémoires de Trévoux,* in which I propose certain general reasons drawn from higher principles, which refute atoms.[378] I could offer still others, for my whole system is opposed to them.

As concerns the disputes between Gassendi and Descartes, I find that Gassendi was right in rejecting some alleged demonstrations of Descartes about God and the soul. Fundamentally, however, I believe that the opinions of Descartes are the better, even though they have not been sufficiently demonstrated. Gassendi, instead, seems to me to waver too much on the nature of the soul and, in a word, on natural theology.

It appears from a letter of Mr. Locke to Molyneux which is printed in Locke's posthumous correspondence that this able Englishman could not willingly endure criticism. Since his reply to my criticisms had not been communicated to me, he did not make it possible to answer him. I do not know whether my comments are found in this collection in their entirety.

In my Theodicy I have expressed my opinion on the question of the action of God and creatures, which is being so actively discussed now. If I am to examine the matter more deeply, it seems to me that I shall have to hold to what I have said there. But I should not be unwilling, some day, to examine the criticisms against Malebranche and his replies to them. These questions lack clarity because we do not have good definitions. . . .

IV

[G., III, 634-40]

Hanover, February 11, 1715

Your letters always reveal your kindness and intelligence alike; I should like to deserve the former and to satisfy the latter. The lack of confidence which I feel about my health has prevented me from accompanying Her Highness, the Princess of Wales. Indeed, the gout has since seized me; it is not so very painful, but it prevents me from working outside my study, where I always find time too short, and am therefore never bored. This is a joy in my misfortune.

I come to your difficulties, and I thank you for stating them, Sir, for I ask for nothing more than to receive objections from people of your sincerity and penetration.

1. As for metempsychosis, I believe that the universal order does not permit it; it demands that everything should be explicable distinctly and that nothing should take place in a leap. But the passage of the soul from one body to another would be a strange and inexplicable leap. What happens in an animal at present happens in it always; that is, the body is in continuous change like a river, and what we call generation or death is only a greater or quicker change than ordinary, as would be a waterfall or cataract in a river. But these leaps are not absolute, and of the kind which I reject, as would be that of a body which went from one position to another without passing through the intervening space. Such leaps are prohibited not only in motion but also in the whole order of things or of truths. This is why I have shown, in the letters to Mr. Hartsoeker recently printed in the Mémoires de Trévoux, that the assumption of a void and atoms would lead us to such leaps. But just as there are certain outstanding points in a geometric curve which are called summits, bend points, points of return, or some other thing, and as there are curves which contain an infinity of them, even so there must be conceived in the life of an animal or a person times of extraordinary change which do not fall without the general rule—as the distinctive points of a curve can be determined by its general nature or its equation. We can always say of an animal that everything is just as it is now; the difference is only that of more or less.

2. Since it is possible to conceive that by a development and change of matter the machine which constitutes the body of a spermatic animal can become such a machine as is necessary to form the organic body of man, it is also necessary for a soul which is only sensitive to become a reasonable soul, because of the perfect harmony between the soul and the machine. But since this harmony is pre-established, the future state will already be contained in the

present, and a perfect intelligence would recognize the future man far in advance in the present animal, as much in its soul alone as in its body alone. Thus a mere animal will never become a man, and the human spermatic animals which do not pass into this great transformation through conception are mere animals.

3. There are undoubtedly a thousand derangements, a thousand disorders, in particular. But it is impossible that there should be any in the whole, even in each monad, since each monad is a living mirror of the universe according to its point of view. It is impossible that the universe as a whole should not be well regulated, since the superiority of its perfections is the reason for the existence of this system of things in preference to any other possible system. Thus the disorders must exist only in the parts. Just so there are geometric curves the parts of which are irregular, but, when the entire curve is considered, one finds it to be perfectly regulated according to its equation or general nature. So all these particular disorders are redressed with benefit in the whole, even in each monad.

4. As for the inertia of matter, since matter itself is nothing but a phenomenon—though well founded—which results from the monads, this is also true of inertia, which is a property of this phenomenon. It is necessary that matter should seem to be something which resists motion and that a small body in motion or with force could not impart it to a great body at rest without losing its own; otherwise the effect would exceed the cause, that is, there would be more force in the succeeding state than in the preceding one. Thus it would appear that matter is something which resists the motion which one tries to impart to it. But in the interior of things, since absolute reality rests only in the monads and their perceptions, these perceptions must be well regulated; that is, the rules of fitness must be observed, one of which orders that the effect must not exceed its cause. If matter were a substance, as it is commonly thought to be, it could not (without a miracle) observe the rules of fitness, and, left to itself, it would observe certain

brute laws depending upon a mathematical necessity and absolutely separated from experience. I said something about this some years ago in one of the Paris journals, in reply to the Abbé Catelan, I believe, and I regret not being able now to give you the year and the number.[379] Furthermore, since all monads (except the primitive one) are subject to passions, they are not pure forces; they are the foundation not only of actions but of resistance and passivity, and their passions are found in their confused perceptions. It is in this that matter or the numerically infinite is involved.

You see, Sir, that I make an effort always to satisfy you, and, as you see, by using the same principles. But I do not know if I have succeeded. If there remain difficulties for you, the more you explain them, the more I shall be in a position to enter into them and either give up my view or satisfy you.

I have always been most satisfied, from my very youth, with the ethics of Plato and in some ways with his metaphysics as well; these two sciences demand each other's company, as do mathematics and physics. If someone were to reduce Plato to a system, he would render a great service to mankind, and it would then be clear that my own views approach his somewhat. The late Mr. Boileau spoke a little too much like a Jansenist when he called the ancients "these damned ancients." The Jesuits are more reasonable in this matter. But I believe that Boileau was trying to jeer. When I was a young boy, the students of my day sang: "Summus Aristoteles, Plato, et Euripides, ceciderunt in profundum."[380]

When I made my comments on the little work on the uses of raillery, I did not know that Lord Shaftesbury was its author. Nor did I give my notes to anyone, contenting myself with reading them to Madame the Electress. I found afterward that Lord Shaftesbury had corrected himself remarkably as his thought progressed and that from a Lucian he had become a Plato—certainly an unusual metamorphosis, and one which made me regret his loss greatly. Also, I spoke in an entirely different tone in commenting on his Characteristics.[381] I shall send you a copy of my first comments, however.

But here are some slight reflections of an entirely different nature which I take the liberty of sending you, Sir, and I beg you, after having read them and even having them copied, if you wish, to put them in the letter by quick post addressed to the Abbé de St.-Pierre; I pray you to have this sealed and sent thus to the Abbé Varignon along with the letter for him. For it is he who sent me the letter of the Abbé de St.-Pierre, along with his work on the Project for Perpetual Peace, about which the author had asked my opinion. This project shows excellent intentions and contains sound reasoning.[382] It is very certain that, if men wished, they could free themselves of these three scourges—war, pestilence, and famine. As for the last two, every sovereign wants this, but against war this accord of sovereigns is still lacking and is difficult to obtain. This interesting subject could receive very great elaboration, particularly through historical studies. . . .

69

Letters to Louis Bourguet

1714-15

An early supporter of Leibniz's views, with a keen interest in their applications to natural science, Louis Bourguet (1678-1742) was a merchant and scholar of broad interests who lived in Venice from 1711 to 1715. The correspondence of the two men began in 1709 on matters relating to the origin of the alphabet, proceeded to problems of the *Theodicy,* and later raised important questions about Leibniz's consistency in matters of physics, biology, and historical change.

* * *

[G., III, 572-76]

Hanover, December . . . , 1714

I have at last received the letter which you sent by Mr. Hermann, and I am pleased to see your comments on my *Theodicy*. I quite agree that the idea of possibles necessarily implies the *idea of the existence* of a being who could produce the possible. But the idea of possibles does not at all imply the *existence itself* of this being, as you seem to hold when you say, "If there were no such being, nothing would be possible." In order for the thing to be possible, it suffices that a being should be possible capable of producing the thing. Generally speaking, if a thing is to be possible, it suffices that its efficient cause should be possible; I make an exception of the supreme efficient cause, which must exist in fact. But this belongs to another chapter—that nothing would be possible if the necessary being did not exist. This is because the reality of possibles and of eternal truths must be founded upon something real and existent.

I do not agree that, "in order to know if the romance of 'Astrea' is possible, it is necessary to know its connections with the rest of the universe." It would indeed be necessary to know this if it is to be *compossible* with the universe, and as a consequence to know if this romance has taken place, is taking place, or will take place in some corner of the world, for surely there would be no place for it without such connections. And it is very true that what is not, never has been, and never will be is not possible, if we take the *possible* in the sense of the *compossible*, as I have just said. It may be that Diodorus, Abélard, Wycliffe, and Hobbes had this idea in their heads without completely untangling it. But whether the "Astrea" is possible in an absolute sense is another question, to which I answer "Yes," because it does not imply any contradiction. Yet in order for this novel to exist in fact, it would be necessary for the rest of the universe also to be entirely different from what it is—and it is possible that it should be otherwise.

I am in no greater agreement, Sir, with your added remark that, "in order to be sure that there is an infinity of possible worlds, we should have to think of them as ended and determined." This comes from the same confusion of possibles for compossibles. When you say that "one world that is infinite (in every respect) must in a sense include all possible worlds," I agree—in the sense which I have given, taking possibles to mean compossibles.

You also say that "one infinite series contains all possible numbers." I cannot agree with this either, for the series of square numbers is infinite, yet it does not contain all possible numbers. You add to this the words: "If one considers the universe as a collection, one cannot say that there could be many worlds in it." This would be true if the universe were a collection of all possibles, but it is not, since all possibles are not compossible. Thus the universe is a collection of a certain order of compossibles only, and the actual universe is a collection of all the possibles which exist, that is to say, those which form the richest composite. And since there are different combinations of possibilities, some of them better than others, there are many possible universes, each collection of compossibles making up one of them.

I can see no reason why "one cannot say in a rigorous sense that our intellects conceive of possibilities which will never exist." Perhaps there are figures of geometry and of surd numbers which have never existed and never will. Are they any the less possible, that is to say, less knowable? "Everything which comes from God (you say) necessarily bears the characteristics of order, and consequently is admitted to existence as the product of his perfections." These are your words, with which I agree. They prove that only the best exists but not that only the best is possible—unless you change the meaning of terms. I call possible anything which is perfectly conceivable and which, as a result, has an essence or an idea, without raising the question of whether the rest of the world permits it to become existent.

So far I have given an exact analysis of your objections, after which there is no need to run through what you say about the actions of God and of intelligent creatures, about a private man becoming king, about the journey of someone like Bacchus or Hercules to India, about the possibility of sin, etc. It seems to me that these objections are the aftereffects of reading Mr. Poiret. But when you say that "to hold that a world without evil, preferable in order to ours is impossible, is to let Mr. Bayle win," I do not rightly understand the reasons which you offer, for what you say contains no "becauses" or "therefores." So I do not consider it an objection.

You add that "evil counts for nothing in the decisions of God." If this is understood as you seem to explain it a little later, that "the consideration of evil is not great enough to counterbalance the good," I agree with it. In this way the striving for the greatest good still involves the admission of moral evil, though it seems that you would prefer to agree to this only for metaphysical evil, or at most for some physical evil, though you add no reason for this limitation. "As for metaphysical evil (you say) I do not consider it as evil." But if you admit that there is metaphysical good, Sir, the privation of this good will be metaphysical evil. When an intelligent being loses his understanding without any pain and without sin—and therefore without any physical or moral evil—do you not consider this as an evil? In any case you would merely be changing the meaning of terms.

So I find, Sir, that you could have satisfied all your doubts if you had taken the pains to think carefully about what I have already said. Yet I am glad that I have been able to show you this.

What you say about the development of life seems to me well taken. Those human seminal animals which never attain a development of reason do not have this reason enveloped within them.

In the way in which I define perception and appetite, all monads must necessarily be endowed with them. I hold perception to be the representation of plurality in the simple, and appetite to be the striving from one perception to another. But these two things occur in all monads, for otherwise a monad would have no relation to the rest of the world. I do not see how you can deduce any Spinozism from this; to do so is to jump at conclusions. On the contrary, it is through these very monads that Spinozism is destroyed, for there are just as many true substances, as many living mirrors of the universe which subsist always, or as many concentrated universes, as there are monads; according to Spinoza, on the contrary, there is only one substance. He would be right if there were no monads; then everything except God would be of a passing nature and would vanish into simple accidents or modifications, since there would be no substantial foundation in things, such as consists in the existence of monads. . . .

II

[G., III, 580-83]

Hanover, August 5, 1715

. . . You are right, Sir, in taking offense at the none too courteous remarks of the author of the Preface to Mr. Newton's second edition,[383] and I am astonished that Mr. Newton let it pass. They should have spoken of Mr. Descartes with more respect, and with more moderation of his followers. As far as I and my friends are concerned, whom they also had in mind, they are angry because their alleged "attractive force" was criticized in the Leipzig Acts, though with much restraint, as being merely a revival of chimeras which had already been banned. They commit a shrewd sophism to give themselves an air of reasonableness and to make us appear in the wrong, as if we were opposing those who assume gravity, without giving a reason for it. This is not at all true; we rather disapprove of the method of those who assume irrational qualities, as the Scholastics once did, that is, primary qualities which have no natural reason, to be explained by the nature of the subject to which the quality must belong. We agree and maintain with them, and have maintained even before they published their view, that the great globes of our system, having a certain magnitude, attract each other. But since we hold that this can happen only in a way that has an explanation, namely, by the impact of more subtle bodies, we cannot admit that attraction is a primary property essential to matter, as these gentlemen claim. It is this opinion which is false, based on a hasty judgment, and incapable of being proved by phenomena. This error has produced their second one, namely, that there must necessarily be a vacuum. They see rightly that their pretended mutual attraction between all the parts of matter would be useless and without effect if everything were full. I will not reply to men who attack me in a crude and unkind manner. According to these authors, substances would not only be unknown to us, as you well remark, Sir; it would even be impossible for anyone, whoever he might be, to know them. God himself could not know them if their nature is such as these men say. The only thing they can reply to this with any appearance of reason will be that God makes them act in this way by a miracle or, better, that he acts for them. So we should have to return to the Mosaic philosophy of Robert Fludd, which Gassendi gave its fitting treatment in a special work.[384] Similarly, when Roberval said, in his Aristarque, that the planets attract each other—a remark which he may have understood in its right sense—Descartes, taking it in the sense of our new philosophers, made himself merry over it in a letter to Father Mersenne.[385]

You would oblige me by telling me where Mr. Clarke, Mr. Ditton, and others make use of the principle which I have put forward—that God has chosen the best possible plan. I am too busy to be able to do enough reading.

Of what the perception of plants consists, we cannot say; indeed, we do not even have any good conception of that of animals. But it is enough to say that the plant has a variety in unity and therefore has a perception; and it is enough that it has a tendency toward new perceptions and therefore appetite, in the general sense in which I use these terms. Mr. Swammerdam has supplied observations which show that insects are close to plants with respect to their organs of respiration and that there is a definite order of descent in nature from animals to plants. But perhaps there are other beings between these two.

As for the nature of succession, where you seem to hold that we must think of a first, fundamental instant, just as unity is the foundation of numbers and the point is the foundation of extension, I could reply to this that the instant is indeed the foundation of time but that, since there is no one point whatsoever in nature which is fundamental with respect to all other points and which is therefore the seat of God, so to speak, I likewise see no necessity whatever of conceiving a primary instant. I admit, however, that there is this difference between instants and points—one point of the universe has no advantage of priority over another, while a preceding instant always has the advantage of priority, not merely in time but in nature, over following instants.[386] But this does not make it necessary for there to be a first instant. There is involved here the difference between the analysis of necessities and the analysis of contingents. The analysis of necessities, which is that of essences, proceeds *from the posterior by nature to the prior by nature*, and it is in this sense that numbers are analyzed into unities. But in contingents or existents, this analysis *from the posterior by nature to the prior by nature* proceeds to infinity without ever being reduced to primitive elements. Thus the analogy of numbers to instants does not at all apply here. It is true that the concept of numbers is finally resolvable into the concept of unity, which is not further analyzable and can be considered the primitive number. But it does not follow that the concepts of different instants can be resolved finally into a primitive instant. Yet I do not venture to deny that there may be a first instant. Two hypotheses can be formed—one that nature is always equally perfect, the other that it always increases in perfection. If it is always equally perfect, though in variable ways, it is more probable that it had no beginning. But if it always increases in perfection (assuming that it is impossible to give it its whole perfection at once), there would still be two ways of explaining the matter, namely, by the ordinates of the hyperbola *B* or by that of the triangle *C* (Fig. 38). According to the hypothesis of the hyperbola, there would be no beginning, and the instants or states of the world would have been increasing in perfection from all eternity. But, according to the hypothesis of the triangle, there would have been a beginning. The hypothesis of equal perfection would be that of

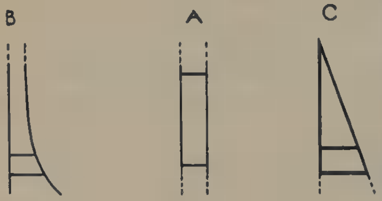


Fig. 38

rectangle A. I do not yet see any way of demonstrating which of these we should choose by pure reason. But though the state of the world could never be absolutely perfect at any particular instant whatever according to the hypothesis of increase, nevertheless the whole actual sequence would always be the most perfect of all possible sequences, because God always chooses the best possible.

When I say that unity is not further analyzable, I mean that it cannot have parts whose concept is simpler than it. Unity is divisible but not resolvable, for fractions, which are parts of unity, have less simple concepts than whole numbers, which are less simple than unity, since whole numbers always enter into the concepts of fractions. Many who have philosophized about the point and about unity in mathematics have become confused by failing to distinguish between analysis into concepts and division into parts. Parts are not always simpler than wholes, though they are always less than the whole. . . .

70

THE METAPHYSICAL FOUNDATIONS OF MATHEMATICS

After 1714

In spite of the distractions of which he complained in the last years of his life, especially the burdensome history of the House of Brunswick, of which he was never free, Leibniz had occasion to return to his earlier studies in mathematics and logic. This paper, first published from the Hanover manuscripts by Gerhardt, continues and pushes to a higher degree of generality the geometrical studies of 1679 (Vol. I, No. 27). It is part of an effort to base a universal mathematical doctrine of quantity and quality, space and time, upon the relations and processes of the universal characteristic. The relations of similarity and congruence used in the earlier studies are combined in those of homogeneity, and the principle of continuity is generalized into homogony. Specifically, algebra and analytic geometry, on the one hand, and Leibniz's own geometry of situation, on the other, are presented as special determinations of his science of characters, the former based on quantity, the latter on quality.

* * *

[GM., VII, 17-29]

In his Latin course in mathematics (see the Acta eruditorum for 1714), the distinguished mathematician Christian Wolff has recently mentioned certain ideas of mine about the analysis of axioms and the mathematical nature of similarity and has explained them in terms of his method.[387] I should like therefore to present here, lest they be lost, certain views which I worked out some time ago, from which it will be clear that there is an art of analysis more inclusive than mathematics, from which mathematical science derives its most beautiful methods. To do this I shall have to introduce a somewhat higher order of principles.

If a plurality of states of things is assumed to exist which involve no opposition to each other, they are said to exist simultaneously. Thus we deny that what occurred last year and this year are simultaneous, for they involve incompatible states of the same thing.

If one of two states which are not simultaneous involves a reason for the other, the former is held to be prior, the latter posterior. My earlier state involves a reason for the existence of my later state. And since my prior state, by reason of the connection between all things, involves the prior state of other things as well, it also involves a reason for the later state of these other things and is thus prior to them. Therefore whatever exists is either simultaneous with other existences or prior or posterior.

Time is the order of existence of those things which are not simultaneous. Thus time is the universal order of changes when we do not take into consideration the particular kinds of change.

Duration is magnitude of time. If the magnitude of time is diminished uniformly and continuously, time disappears into a moment, whose magnitude is zero.

Space is the order of coexisting things, or the order of existence for things which are simultaneous. In each of the two orders—that of time and that of space—we can judge relations of nearer to and farther from between its terms, according as more or less middle terms are required to understand the order between them. Thus two points are nearer if the maximally determined intervening forms arising from them produce a simpler configuration. Such an interval of maximum determination, that is, the minimum and at once the most conformal figure made by the intervening terms is the simplest path from one to the other; in the case of points this is the straight line, which is shorter between nearer points.[388]

Extension is magnitude of space. It is wrong to confuse extension with what is extended, as is commonly done, and so to consider it as a substance. If the magnitude of space is decreased continuously and uniformly, it disappears in a point which has no magnitude.

Situs is a mode of coexistence. Therefore it involves not only quantity but also quality.

Quantity or magnitude is that in things which can be known only through their simultaneous compresence—or by their simultaneous perception. Thus it is impossible for us to know what a foot or a yard is unless we actually have something to serve as a measure which can be applied to successive objects after each other. A foot or a yard can therefore not be explained adequately by a definition; that is, by one which does not include something similar to the thing defined. For though we may say that a foot is twelve inches, the same question arises concerning the inch, and we gain no greater insight, for we cannot say whether the notion of the inch or of the foot is prior in nature, since it is entirely arbitrary which we wish to assume as basic.

Quality, on the other hand, is what can be known in things when they are observed singly, without requiring any compresence. Such are the attributes which can be explained by a definition or through the various modes which they involve.[389]

Equals are things having the same quantity. Similars are things having the same quality. Hence, if two similar things are different, they can be distinguished only when they are co-present.

From this it is clear, for example, that two equiangular triangles have their sides proportional, and the converse. For if the sides are proportional, the triangles are similar, since they may be determined in a similar way. Furthermore, the sum of the angles in all triangles is the same, since it is equal to two right angles; therefore the ratio of each angle in one triangle to the sum must necessarily correspond to the ratio of the corresponding angle in the other triangle to the sum, for otherwise one triangle could be distinguished from the other by this fact itself, that is, without further comparison and in itself. In this way we can easily demonstrate what otherwise would require many devious detours.[390]

Two entities are homogeneous to which two other entities can be assigned which are equal to them and similar to each other. Given A and B; if L is taken equal to A, and M equal to B, and L and M are similar, we call A and B homogeneous. Hence I usually say also that homogeneous entities are those which can be made similar to each other by means of transformations, like curves and straight lines. That is, if A is transformed into its equal L, it can be made similar to B, or to its equal M into which B is assumed to have been transformed.

We say that an entity is in [inesse] some locus, or is an ingredient of something, if, when we posit the latter, we must also be understood, by this very fact and immediately, without the necessity of any inference, to have posited the entity as well. Thus when we posit any finite line, we also posit its end points as belonging to it.

An entity which is in something and is also homogeneous to it is called a part, and that which it is in is called a whole; or a part is a homogeneous ingredient of a whole.[391]

A common boundary of two things is an entity which is in them when they do not have a part in common. Insofar as these two things are understood to be parts of a single whole, their common boundary is called a section of the whole.

It is clear from this that a boundary is not homogeneous with what it bounds, nor a section with what it cuts.

Although they are not homogeneous, time and a moment, space and a point, boundary and the bounded, are nevertheless homogonous, because one can disappear into the other by a process of continuous change.

If one locus is said to be in another locus, we understand it to be homogonous to it; if it is also a part, or equal to a part of the other locus, it will be not merely homogonous but also homogeneous. Although an angle is at a point, it is not in a point; otherwise a point would be understood to have magnitude.

If a part of one thing is equal to the whole of another, the former is called *greater*, the latter *less*. Hence *the whole is greater than a part*. For let the whole be *A*, the part *B*. Then *A* is greater than *B*, because a part of *A* (namely, *B*) is equal to the whole of *B*. This can be expressed in a syllogism whose major proposition is a definition, its minor an identity:

> Whatever is equal to a part of *A* is less than *A*, by definition.
> But *B* is equal to a part of *A* (namely, to *B*), by hypothesis.
> Therefore *B* is less than *A*.

Here we see that demonstrations are finally resolvable into two kinds of indemonstrables: *definitions* or ideas, and *primitive propositions* or identities, such as *B* is *B*, anything whatever is equal to itself, and a great many others of this kind.

Motion is change of situs. We say that *a thing is moved* if there is in it a change of situs and at the same time a reason for this change.

The mobile is homogonous to the extended, for even a point is thought of as movable.

A *path* is the continuous and successive locus of a movable thing.

A *trace* [*vestigium*] is the locus of a movable thing, which it occupies at some moment. Thus the trace of the boundary of a moving thing is a section of the path which the boundary describes, assuming, namely, that the movable thing does not move within its own trace. A movable thing is said to *move within its own trace* when each of its points, with the exception of its boundary, continuously and successively moves into the position of another point of the same thing. But, assuming that the movable thing does not move in this way, then a *line* is the path of a point.

A surface is the path of a line. A filled space [amplum] or what is commonly called a solid is the path of a surface. The magnitudes of the paths in which points describe lines, lines surfaces, and surfaces solids are called length, breadth, and depth. These are called dimensions, and in geometry it is shown that there are only three.

An entity has breadth if its section has extension or if its boundary is extended. An entity has depth if it does not terminate anything extended or if it cannot be a section of the extended; clearly there is something more in depth than what can be a boundary.

A line is the ultimate extended terminating entity. A solid is the ultimate extended terminated entity.

Similarity or dissimilarity in solids or in space is recognized on the basis of their boundaries; thus, since a solid is something more than what can be a boundary, it is internally everywhere similar. Solids whose boundaries completely coincide are congruent, and are assimilated, themselves coincide, are congruent and similar. The same thing is true in a plane, which is a surface internally uniform or similar to itself, and in a straight line, which is a line internally similar to itself.

The complete boundary of an extended thing having breadth can be called its perimeter [ambitus]. Thus the perimeter of a circle is its circumference; that of a sphere is the spherical surface.

A point (i.e., of space) is the simplest locus, or the locus of no other locus. Absolute space is the fullest locus, or the locus of all loci. Nothing results [prosultare] from a single point.

From two points something new results, namely, the locus of all the points which are uniquely determined by their situation in relation to the two given points, that is, the straight line which passes through the two points.

From three points there results a plane, that is, the locus of all points whose situation is uniquely determined in relation to three points not falling in the same straight line.

From four points not falling in the same plane there results absolute space. For every point whatsoever is uniquely determined by its situation in relation to four points not falling in the same plane.

I use the word "to result" to indicate the determination of a new idea; that is, when, on the basis of certain assumed data, something else is uniquely determined by a specific relation to these data. In the present case the relationship involved is that of situs.

Time can be continued to infinity. For since a whole of time is similar to a part, it will be related to another whole of time as its part is to it. Thus it must always be understood as capable of being continued into another greater time. Similarly, solid space or amplitude can also be continued to infinity, since any of its parts can also be taken as similar to the whole. In the same way a plane and a straight line can also be continued to infinity. The same argument can be used to show that space, as well as a straight line and time, or, in general, any continuum, can be subdivided to infinity. For in a straight line as in time, a part is similar to the whole and can therefore itself be cut in the same ratio as the whole. Though there are extended things in which the part is not similar to the whole, they can nevertheless be transformed into entities in which this is true and can thus be cut in the same ratio as that into which they are transformed.

From these considerations it follows also that for every given motion we can posit another that is faster or slower in a given ratio, for if a rigid ray be moved about one of its points as center, the motions of its points are proportional to their distance from the center, so that the velocities will vary as the distances.

The estimation of magnitude is of two kinds, imperfect and perfect. It is imperfect when we say something is greater or less than another, although they are not homogeneous and have no ratio between them; as, for instance, when it is said that a line is greater than a point, or a surface than a line. It was in this sense that Euclid said that the angle of contact [of a tangent to a circle] is less than any straight-lined angle, though there is no true comparison between these two entirely distinct types, since they are not homogeneous, nor can one pass into the other by continuous change. In perfect estimations of the quantity of homogeneous entities, the rule must hold that all intermediate states can be passed through in moving continuously from one extreme to another. This rule does not hold in imperfect estimations, because what we here call intermediate states are heterogeneous, Thus, in passing over from a given acute angle to a right angle, one does not pass through the angle which a diameter or radius makes with the circumference of a circle, although this angle is said to be less than a right angle and greater than any acute angle. Here "greater" is incorrectly taken to mean that one thing falls entirely within the boundaries of another.

There are many relations according to quantity; thus two straight lines can have the relation to each other that their sum is equal to a constant straight line. There can be an infinite number of pairs of straight lines, x and y, which have the relation, $x + y = a$. So, for example, if a is 10, x and y can be 1 and 9, 2 and 8, 3 and 7, 4 and 6, 5 and 5, 6 and 4, 7 and 3, 8 and 2, 9 and 1. But there can also be an infinite number of fractions within 10 which satisfy the condition. We can also have a relation between two straight lines such that the sum of their squares equals the square of a given straight line a, or that $x^2 + y^2 = a^2$, and, of these, there could also be an infinite number of pairs. In the circle this is the relation between the sine of any angle and the sine of its complementary angle, or the opposite, if either one is x, the other is y, and the radius is a. An infinite number of such relations can be devised, as many as there are kinds of curves which one can describe in a plane. For instance, if the x's are taken as abscissas on a horizontal line, the y's are ordinates parallel to each other applied vertically to the abscissas, whose ends form a curve.

The simplest of all relations is that called ratio or proportion, and this is the relation between two homogeneous quantities which arises from themselves alone without assuming a third homogeneous quantity. So if y is to x as any number is to unity, or $y = nx$, x being taken as abscissa, and y as ordinate, the locus, or the line in which the ordinates end, is a straight line. It is also clear from this that if there be an equation of any degree for the locus, such as $lx^3 + my^3 + nx^2y + pxy^2 = 0$, where l, m, n, and p are specific numbers, the locus to which the equation will apply will be a ratio between these same x's and y's. . . .[392]

. . . It is also to be noted that the whole of algebra is an application to quantities of the *art of combinations*, or of the science of abstracted forms, which is the universal characteristic and belongs to metaphysics. So the product of the multiplication of $a + b + c +$ etc. by $l + m + n +$ etc. is nothing but the sum of all the binary combinations which can be built out of the letters of the two series, and the product of the three series $a + b + c +$ etc., $l + m + n +$ etc., and $s + t + v +$ etc. is the sum of all the ternary combinations which can be built from the three series of letters. Other forms will be produced from other operations.

Thus our calculation usefully obeys not only the law of homogeneous entities but also the law of *justice* [*lex justitiae*],[393] according to which the relations between entities in our conclusions or results must correspond to the similar relations in the data, and must therefore be treated in the same way in mathematical operations, insofar as this is practical. The proposition is true in general that, when the data proceed in a certain order, the conclusions proceed in a corresponding order. From this arises also the *law of continuity* which I was the first to formulate, according to which the law of bodies at rest is, as it were, a special case of the law of bodies in motion; the law of equals, as it were, a special case of the law of unequals; the law of curves, as it were, a special case of the law for straight lines. This is always true when a transition is possible from a genus to its limit in a special case which is its apparent opposite. Here belongs also the method of reasoning which geometricians have long admired, in which they make use of an initial hypothesis to prove its opposite, by first treating it as a special case and then finding it to be disparate and opposite from the original problem.[394] This is the advantage of the continuous. But continuity is found in time, extension, qualities, and movement—in fact, in all natural changes, for these never take place by leaps.

Situs is a certain relationship of coexistence between a plurality of entities; it is known by going back to other coexisting things which serve as intermediaries, that is, which have a simpler relation of coexistence to the original entities.

But we know as coexisting, not merely those things which we perceive together, but also those which we perceive successively, provided only that, during the transition from the perception of one to that of the other, the former is not destroyed and the latter generated. From the latter requirement it follows that both coexist now, at the present moment in which we attain the latter perception; from the former it follows that both existed when we experienced the former thing.

There is, moreover, a definite order in the transition of our perceptions when we pass from one to the other through intervening ones. This order, too, we can call a path. But, since it can vary in infinite ways, we must necessarily conceive of one that is most simple, in which the order of proceeding through determinate intermediate states follows from the nature of the thing itself, that is, the intermediate stages are related in the simplest way to both extremes. If this were not the case, there would be no order and no reason for distinguishing among coexisting things, since one could pass from one given thing to another by any path whatever. It is this minimal path from one thing to another whose magnitude is called distance.[395]

To make this more understandable, we shall now leave out of consideration all that we see in the particular things in which distance is involved and consider them as if they contained no plurality of properties; that is, we shall consider them as points. For that is a point in which nothing else can be assumed to coexist, so that whatever is in it is it.

Then the path of a point will be a line, and this cannot have breadth, since its section, a point, can have no length. Nothing further is determined by one given point. But two points determine the simplest path from one to the other, which we designate as a straight line.

1. From this it follows, in the *first* place, that a straight line is the shortest distance between two points or that its magnitude is the distance between the points.

2. *Second*, the straight line is uniform between its extremities. For there is no determining factor given from which we can infer a reason for variation.

3. It follows necessarily, therefore, that one locus of a point moving along it can be distinguished from another only in relation to its extremities. Hence any part of a straight line is also straight, and a line is everywhere internally similar to itself, nor can two parts be distinguished from each other if they cannot be distinguished by means of their extremities.

4. It follows also that, if the extremities of two lines are taken to be similar, congruent, or coincident, the lines themselves will be similar, congruent, or coincident. But extremities are always similar; therefore two straight lines are always similar, as is every part to its whole.

5. In the *third* place, it follows from the definition that a straight line passes through those points which have a unique relation to the two given points, this relation being that of maximal determination. There must necessarily be such points, otherwise no further determinations whatever could result from two points. If there were any other point related in the same way to *A* and *B* together as are the proposed points, there would be no reason why that simplest path sho be determined by these given points rather than by that other one. This is also clear from what has preceded, where we showed that a straight line is determined if its extremities are given or that lines coincide when their extremities coincide.

6. *Fourth*, it follows that a straight line is uniform in all direc-

tions; it is neither concave nor convex as is a curve, since no reason for such diversity can be derived from two given points.

7. Hence it follows that, if any two points, *L* and *M*, are taken outside of the line in such a way as to be related in the same way to two points on the line, or in such a way that the relation of *L* to *A* and *B* is identical with that of *M* to *A* and *B*, they will also have an identical relationship to the entire line, or *L* will be related to the line *AB* in exactly the same way as *M* is related to it.

8. It is also clear that a rigid straight line, or one whose points do not change their situs with respect to each other, cannot move if two points in it are fixed. Otherwise there would be many points having the same relations to the two fixed points—namely, the situation in which the moving point was before it moved, and that to which it moved.

9. It follows conversely that all other points which do not fall on a straight line *AB* or which do not lie in the direction *AB* can be moved without changing their situs in relation to *A* and *B*, if *A* and *B* remain fixed. For the straight line is the locus of all points having a unique relation to *A* and *B*; therefore all other points can be varied, and in any direction, since the straight line has the same relations in all directions.

10. Therefore if a rigid solid is moved in such a way that two points remain fixed, all its points which remain at rest will fall on a straight line passing through the fixed points; any moving point will describe a circle about that same straight line as axis.

Given three points which do not fall in the same straight line, the figure uniquely determined by them is a *plane*. Let *A*, *B*, and *C* be three points not falling in the same straight line; then the points *A* and *B* determine a straight line *AB*, and points *B* and *C* determine the straight line *BC*. But any point on the line *AB*, together with any point on the line *BC*, determines a new straight line, and hence, given three points *A*, *B*, and *C*, an infinite number of straight lines is determined whose locus is called the plane.

1. Hence, in the *first* place, a plane is the smallest surface

within a given boundary. Its perimeter does not consist in a straight line, because a straight line does not inclose space; otherwise a part of the straight line would be dissimilar to the whole. If the perimeter is given, therefore, three points not falling in the same straight line are also given, and so the given perimeter determines only the plane which it bounds, and this plane must be a minimum.

2. *Second*, a plane is uniform within its boundaries, since no reason can be found in its origin for any variation.

3. Hence it follows that a plane is everywhere internally similar to itself, so that the momentary locus of any point moving within it cannot be distinguished from any other locus except in relation to the boundaries of the plane. Nor can one part of a plane be distinguished from another part except through their boundaries.

4. It follows further that planes whose perimeters are similar or congruent or coincident are themselves similar, or congruent, or coincident.

5. *Third,* it is clear from the definition of a plane that it is the locus of all points uniquely determined in relation to three given points.

6. *Fourth*, it follows that a plane is related in the same way to both sides of it, and so is neither concave nor convex.

7. If a point has a definite relation to *A*, *B*, and *C* at the same time, or to the plane determined by them, then there is another point which has the same relation to these three points and to their plane, since no reason can be given for a difference.

8. The plane possesses *breadth*, for it can be cut by a straight line passing through any two given points on it. Hence its section possesses length. But a figure whose section has length itself has breadth.

Given four points not in the same plane, the result is *depth*, or a figure in which there is something which cannot serve as a boundary, or which cannot be common to itself and to some other figure unless the latter is included in it as a part.[396] . . .

71

The Controversy between Leibniz and Clarke

1715-16

The sharp issues raised between Leibniz's physics and metaphysics and the conceptions of his English rival, Sir Isaac Newton, were clearly and bitterly drawn in the correspondence with Newton's English follower, the theologian Samuel Clarke (1675-1729). The correspondence was mediated by Leibniz's former pupil at Hanover, Caroline, Princess of Wales; and it is clear that Newton himself supplied Clarke with his critical questions and answers. There was not merely objective concern for truth in the letters but animus as well, for Clarke had set out to discredit Leibniz's philosophical and theological pretensions, as the Royal Society had apparently succeeded in discrediting his mathematical originality in the *Commercium epistolicum D. Joh. Collinsii et aliorum de analysi promota*, which it published in 1712. As Leibniz himself explains in writing to Christian Wolff on December 23, 1715, a note which he wrote to the Princess of Wales gave the occasion for Clarke's first reply. Leibniz's death, after nine letters had passed between the correspondents, gave Clarke the last word; though he published his fifth letter,[397] it has not been found among Leibniz's papers.

The historical importance of the controversy is shown in its effects upon later discussions of the problems of physical relativity, causality, and method. The texts are taken, though with modernized spelling, capitalization, and punctuation, from Clarke's edition of the correspondence, and his translation of Leibniz's letters is used (cf. G., VII, 345-440).

* * *

I

Mr. Leibniz's First Paper, Being an Extract of a Letter Written in November 1715

1. Natural religion itself seems to decay [in England] very much. Many will have human souls to be material; others make God himself a corporeal being.

2. Mr. Locke and his followers are uncertain at least whether the soul be not material and naturally perishable.

3. Sir Isaac Newton says that space is an organ which God makes use of to perceive things by. But if God stands in need of an organ to perceive things by, it will follow that they do not depend altogether on him, nor were produced by him.

4. Sir Isaac Newton and his followers have also a very odd opinion concerning the work of God. According to their doctrine, God Almighty[398] wants [i. e., needs] to wind up his watch from time to time; otherwise it would cease to move. He had not, it seems, sufficient foresight to make it a perpetual motion. Nay, the machine of God's making is so imperfect according to these gentlemen that he is obliged to clean it now and then by an extraordinary concourse, and even to mend it as a clockmaker mends his work, who must consequently be so much the more unskilful a workman, as he is oftener obliged to mend his work and to set it right. According to my opinion, the same force and vigor remains always in the world and only passes from one part of matter to another, agreeably to the laws of nature and the beautiful pre-established order. And I hold that when God works miracles, he does not do it in order to supply the wants of nature but those of grace. Whoever thinks otherwise must needs have a very mean notion of the wisdom and power of God.

II

Clarke's First Reply

That there are some in England as well as in other countries who deny or very much corrupt even natural religion itself is very true and much to be lamented. But (next to the vicious affections of men) this is to be principally ascribed to the false philosophy of the materialists, to which the *Mathematical Principles of Philosophy* are the most directly repugnant. That some make the souls of men, and others even God himself, to be a corporeal being is also very true; but those who do so are the great enemies of the *Mathematical Principles of Philosophy*, which principles, and which alone, prove matter or body to be the smallest and most inconsiderable part of the universe.

That Mr. Locke doubted whether the soul was immaterial or no may justly be suspected from some parts of his writings. But herein he has been followed only by some materialists, enemies to the *Mathematical Principles of Philosophy*, and who approve little or nothing in Mr. Locke's writings but his errors.

Sir Isaac Newton doth not say that space is the organ which God makes use of to perceive things by, nor that he has need of any medium at all whereby to perceive things; but on the contrary, that he, being omnipresent, perceives all things by his immediate presence to them, in all space wherever they are, without the intervention or assistance of any organ or medium whatsoever. In order to make this more intelligible, he illustrates it by a similitude: that as the mind of man, by its immediate presence to the pictures or images of things formed in the brain by means of the organs of sensations, sees these pictures as if they were the things themselves, so God sees all things by his immediate presence to them, he being actually present to the things themselves, to all things in the universe, as the mind of man is present to all the pictures of things formed in his brain. Sir Isaac Newton considers the brain and organs of sensation as the means by which those pictures are formed but not as the means by which the mind sees or perceives those pictures when they are so formed. And in the universe he doth not consider things as if they were pictures formed by certain means or organs but as real things formed by God himself and seen by him in all places wherever they are without the intervention of any medium at all. And this similitude is all that he means when he supposes infinite space to be (as it were) the sensorium of the omnipresent being.[399]

The reason why, among men, an artificer is justly esteemed so much the more skilful, as the machine of his composing will continue longer to move regularly without any further interposition of the workman, is because the skill of all human artificers consists only in composing, adjusting, or putting together certain movements, the principles of whose motion are altogether independent upon the artificer. Such are weights and springs and the like, whose forces are not made but only adjusted by the workman. But with regard to God the case is quite different, because he not only composes or puts things together but is himself the author and continual preserver of their original forces or moving powers. And consequently 'tis not a diminution but the true glory of his workmanship that nothing is done without his continual government and inspection. The notion of the world's being a great machine, going on without the interposition of God as a clock continues to go without the assistance of a clockmaker, is the notion of materialism and fate and tends (under pretense of making God a supramundane intelligence)[400] to exclude providence and God's government in reality out of the world. And by the same reason that a philosopher can represent all things going on from the beginning of the creation without any government or interposition of providence, a skeptic will easily argue still further backward and suppose that things have from eternity gone on (as they now do) without any true creation or original author at all but only what such arguers call allwise and eternal nature. If a king had a kingdom wherein all things would continually go on without his government or interposition, or without his attending to and ordering what is done therein, it would be to him merely a nominal kingdom, nor would he in reality deserve at all the title of king or governor. And as those men who pretend that in an earthly government things may go on perfectly well without the king himself ordering or disposing of anything may reasonably be suspected that they would like very well to set the king aside, so whosoever contends that the course of the world can go on without the continual direction of God, the supreme governor, his doctrine does in effect tend to exclude God out of the world.

III

Leibniz's Second Letter

1. It is rightly observed in the paper delivered to the Princess of Wales, which Her Royal Highness has been pleased to communicate to me,[401] that, next to corruption of manners, the principles of the materialists do very much contribute to keep up impiety. But I believe the author has no reason to add that the mathematical principles of philosophy are opposite to those of the materialists. On the contrary, they are the same, only with this difference—that the materialists, in imitation of Democritus, Epicurus, and Hobbes, confine themselves altogether to mathematical principles and admit only bodies, whereas the Christian mathematicians admit also immaterial substances. Wherefore not mathematical principles (according to the usual sense of that word) but metaphysical principles ought to be opposed to those of the materialists. Pythagoras, Plato, and Aristotle in some measure had a knowledge of these principles, but I pretend to have established them demonstratively in my *Theodicy*, though I have done it in a popular manner. The great foundation of mathematics is the principle of contradiction or identity, that is, that a proposition can-

not be true and false at the same time and that therefore *A* is *A* and cannot be non-*A*. This single principle is sufficient to demonstrate every part of arithmetic and geometry, that is, all mathematical principles. But, in order to proceed from mathematics to natural philosophy, another principle is requisite, as I have observed in my *Theodicy*; I mean the *principle of a sufficient reason*, viz., that nothing happens without a reason why it should be so rather than otherwise. And therefore Archimedes, being desirous to proceed from mathematics to natural philosophy, in his book *De aequilibrio*, was obliged to make use of a particular case of the great principle of a sufficient reason. He takes it for granted that if there be a balance in which everything is alike on both sides, and if equal weights are hung on the two ends of that balance, the whole will be at rest. 'Tis because no reason can be given why one side should weigh down rather than the other. Now by that single principle, viz., that there ought to be a sufficient reason why things should be so and not otherwise, one may demonstrate the being of a God and all the other parts of metaphysics or natural theology and even, in some measure, those principles of natural philosophy that are independent upon mathematics; I mean the dynamic principles or the principles of force.

2. The author proceeds and says that, according to the *mathematical principles*, that is, according to Sir Isaac Newton's philosophy (for *mathematical principles* determine nothing in the present case), matter is the most inconsiderable part of the universe. The reason is because he admits empty space besides matter and because, according to his notions, matter fills up a very small part of space. But Democritus and Epicurus maintained the same thing; they differed from Sir Isaac Newton only as to the quantity of matter, and perhaps they believed there was more matter in the world than Sir Isaac Newton will allow; wherein I think their opinion ought to be preferred, for the more matter there is, the more God has occasion to exercise his wisdom and power. Which is one reason, among others, why I maintain that there is no vacuum at all.

3. I find, in express words in the Appendix to Sir Isaac Newton's Optics, that space is the sensorium of God. But the word "sensorium" hath always signified the organ of sensation. He and his friends may now, if they think fit, explain themselves quite otherwise; I shall not be against it.

4. The author supposes that the presence of the soul is sufficient to make it perceive what passes in the brain. But this is the very thing which Father Malebranche and all the Cartesians deny; and they rightly deny it. More is requisite besides bare presence to enable one thing to perceive what passes in another. Some communication that may be explained, some sort of influence, is requisite for this purpose. Space, according to Sir Isaac Newton, is intimately present to the body contained in it and commensurate with it. Does it follow from thence that space perceives what passes in a body and remembers it when that body is gone away? Besides, the soul being indivisible, its immediate presence, which may be imagined in the body, would only be in one point. How then could it perceive what happens out of that point? I pretend to be the first who has shown how the soul perceives what passes in the body.

5. The reason why God perceives everything is not his bare presence but also his operation. 'Tis because he preserves things by an action which continually produces whatever is good and perfect in them. But the soul having no immediate influence over the body, nor the body over the soul, their mutual correspondence cannot be explained by their being present to each other.

6. The true and principal reason why we commend a machine is rather grounded upon the effects of the machine than upon its cause. We don't inquire so much about the power of the artist as we do about his skill in his workmanship. And therefore the reason alleged by the author for extolling the machine of God's making, grounded upon his having made it entirely, without wanting any materials to make it of—that reason, I say, is not sufficient. 'Tis a mere shift the author has been forced to have recourse to, and the reason why God exceeds any other artist is not only because he

makes the whole, whereas other artists must have matter to work upon. This excellency in God would be only on the account of power. But God's excellency arises also from another cause, viz., wisdom, whereby his machine lasts longer and moves more regularly than those of any other artist whatsoever. He who buys a watch does not mind whether the workman made every part of it himself, or whether he got the several parts made by others and did only put them together—provided the watch goes right. And if the workman had received from God even the gift of creating the matter of the wheels, yet the buyer of the watch would not be satisfied unless the workman had also received the gift of putting them well together. In like manner, he who will be pleased with God's workmanship cannot be so without some other reason than that which the author has here alleged.

7. Thus the skill of God must not be inferior to that of a workman; nay, it must go infinitely beyond it. The bare production of everything would indeed show the power of God, but it would not sufficiently show his wisdom. They who maintain the contrary will fall exactly into the error of the materialists and of Spinoza, from whom they profess to differ. They would, in such case, acknowledge power, but not sufficient wisdom, in the principle or cause of all things.

8. I do not say the material world is a machine or watch that goes without God's interposition, and I have sufficiently insisted
that the creation wants to be continually influenced by its creator. 402
But I maintain it to be a watch that goes without wanting to be mended by him; otherwise we must say that God bethinks himself again. No, God has foreseen everything. He has provided a remedy for everything beforehand. There is in his works a harmony, a beauty, already pre-established.

9. This opinion does not exclude God's providence or his government of the world; on the contrary, it makes it perfect. A true providence of God requires a perfect foresight. But then it requires, moreover, not only that he should have foreseen everything but also

that he should have provided for everything beforehand with proper remedies; otherwise he must want either wisdom to foresee things or power to provide against them. He will be like the God of the Socinians who lives from day to day, as Mr. Jurieu says. Indeed, God, according to the Socinians, does not so much as foresee inconveniences, whereas the gentlemen I am arguing with, who put him upon mending his work, say only that he does not provide against them. But this seems to me to be still a very great imperfection. According to this doctrine, God must want either power or good will.

10. I don't think I can be rightly blamed for saying that God is *intelligentia supramundana*. Will they say that he is *intelligentia mundana*, that is, the soul of the world?[403] I hope not. However, they will do well to take care not to fall into that notion unawares.

11. The comparison of a king, under whose reign everything should go on without his interposition, is by no means to the present purpose, since God preserves everything continually and nothing can subsist without him. His kingdom therefore is not a nominal one. 'Tis just as if one should say that a king who should originally have taken care to have his subjects so well educated, and should, by his care in providing for their substance, preserve them so well in their fitness for their several stations and in their good affection toward him,[404] as that he should have no occasion ever to be amending anything among them, would be only a nominal king.

12. To conclude. If God is obliged to mend the course of nature from time to time, it must be done either supernaturally or naturally. If it be done supernaturally, we must have recourse to miracles in order to explain natural things, which is reducing a hypothesis *ad absurdum*, for everything may easily be accounted for by miracles. But if it be done naturally, then God will not be *intelligentia supramundana*; he will be comprehended under the nature of things, that is, he will be the soul of the world.

IV

Clarke's Second Reply

When I said that the Mathematical Principles of Philosophy are opposite to those of the materialists, the meaning was that, whereas materialists suppose the frame of nature to be such as could have arisen from mere mechanical principles of matter and motion, of necessity and fate, the Mathematical Principles of Philosophy show on the contrary that the state of things (the constitution of the sun and planets) is such as could not arise from anything but an intelligent and free cause. As to the propriety of the name, so far as metaphysical consequences follow demonstratively from mathematical principles, so far the mathematical principles may (if it be thought fit) be called metaphysical principles.

'Tis very true that nothing is without a sufficient reason why it is and why it is thus rather than otherwise. And, therefore, where there is no cause, there can be no effect. But this sufficient reason is ofttimes no other than the mere will of God. For instance, why this particular system of matter should be created in one particular place, when (all place being absolutely indifferent to all matter) it would have been exactly the same thing vice versa, supposing the two systems (or the particles) of matter to be alike; there can be no other reason but the mere will of God. Which if it could in no case act without a predetermining cause, any more than a balance can move without a preponderating weight,[405] this would tend to take away all power of choosing and to introduce fatality.

2. Many ancient Greeks, who had their philosophy from the Phoenicians and whose philosophy was corrupted by Epicurus, held indeed in general matter and vacuum, but they knew not how to apply these principles by mathematics to the explication of the phenomena of nature. How small soever the quantity of matter be, God has not all the less subject to exercise his wisdom and power

upon, for other things, as well as matter, are equally subjects on which God exercises his power and wisdom. By the same argument it might just as well have been proved that men, or any other particular species of beings, must be infinite in number, lest God should want subjects on which to exercise his power and wisdom.

3. The word "sensory" does not properly signify the organ but the place of sensation. The eye, the ear, etc., are organs but not sensoria. Besides, Sir Isaac Newton does not say that space is the sensory but that it is, by way of similitude only, as it were, the sensory, etc.

4. It was never supposed that the presence of the soul was sufficient but only that it is necessary in order to perception. Without being present to the images of the things perceived, it could not possibly perceive them. But being present is not sufficient, without it be also a living substance. Any inanimate substance, tho' present, perceives nothing, and a living substance can only there perceive where it is present either to the things themselves (as the omnipresent God is to the whole universe) or the images of things (as the soul of man is in its proper sensory). Nothing can any more act or be acted upon where it is not present than it can be where it is not. The soul's being indivisible does not prove it to be present only in a mere point. Space, finite or infinite, is absolutely indivisible, even so much as in thought (to imagine its parts moved from each other is to imagine them moved out of themselves),[406] and yet space is not a mere point.

5. God perceives things, not indeed by his simple presence to them, nor yet by his operation upon them, but by his being a living and intelligent, as well as an omnipresent, substance. The soul likewise (within its narrow sphere), not only by its simple presence, but by its being a living substance, perceives the images to which it is present and which, without being present to them, it could not perceive.

6 and 7. 'Tis very true that the excellency of God's workmanship does not consist in its showing the power only but in its show-

ing the wisdom also of its author. But then this wisdom of God appears not in making nature (as an artificer makes a clock) capable of going on without him (for that's impossible, there being no powers of nature independent upon God, as the powers of weights and springs are independent upon men). But the wisdom of God consists in framing originally the perfect and complete idea of a work which began and continues according to that original perfect idea by the continual uninterrupted exercise of his power and government.

8. The word "correction" or "amendment" is to be understood, not with regard to God, but to us only. The present frame of the solar system, for instance, according to the present laws of motion, will in time fall into confusion and perhaps, after that, will be amended or put into a new form. But this amendment is only relative with regard to our conceptions. In reality and with regard to God, the present frame, and the consequent disorder, and the following renovation are all equally parts of the design framed in God's original perfect idea. 'Tis in the frame of the world, as in the frame of man's body; the wisdom of God does not consist in making the present frame of either of them eternal but to last so long as he thought fit.

9. The wisdom and foresight of God do not consist in providing originally remedies which shall of themselves cure the disorders of nature. For in truth and strictness, with regard to God there are no disorders, and consequently no remedies, and, indeed, no powers of nature at all, that can do anything of themselves (as weights and springs work of themselves with regard to men). But the wisdom and foresight of God consist, as has been said, in contriving at once what his power and government is continually putting in actual execution.

10. God is neither a mundane intelligence nor a supramundane intelligence but an omnipresent intelligence, both in and without the world. He is in all, and through all, as well as above all.

11. If God's conserving all things means his actual operation

and government in preserving and continuing the beings, powers, orders, dispositions, and motions of all things, this is all that is contended for. But if his conserving things means no more than a king's creating such subjects as shall be able to act well enough without his intermeddling or ordering anything among them ever after, this is making him, indeed, a real creator, but a governor only nominal.

12. The argument of this paragraph supposes that whatsoever God does is supernatural or miraculous, and consequently it tends to exclude all operation of God in the governing and ordering of the natural world. But the truth is, natural and supernatural are nothing at all different with regard to God but distinctions merely in our conceptions of things. To cause the sun (or earth) to move regularly is a thing we call natural; to stop its motion for a day, we call supernatural. But the one is the effect of no greater power than the other, nor is the one, with respect to God, more or less natural or supernatural than the other. God's being present in or to the world does not make him to be the soul of the world.[407] A soul is part of a compound whereof the body is the other part, and they mutually affect each other as parts of the same whole. But God is present in the world, not as a part, but as a governor, acting upon all things, himself acted upon by nothing. He is not far from every one of us, for in him we (and all things) live and move and have our beings.

V

Mr. Leibniz's Third Paper[408]

1. According to the usual way of speaking, mathematical principles concern only mere mathematics, viz., numbers, figures, arithmetic, geometry. But metaphysical principles concern more general notions, such as are cause and effect.[409]

2. The author grants me this important principle, that nothing

happens without a sufficient reason why it should be so rather than otherwise. But he grants it only in words and in reality denies it. Which shows that he does not fully perceive the strength of it. And therefore he makes use of an instance which exactly falls in with one of my demonstrations against real absolute space, which is an idol of some modern Englishmen. I call it an idol, not in a theological sense, but in a philosophical one, as Chancellor Bacon says that there are idola tribus, idola specus.

3. These gentlemen maintain, therefore, that space is a real absolute being. But this involves them in great difficulties, for such a being must needs be eternal and infinite. Hence some have believed it to be God himself, or one of his attributes, his immensity. But since space consists of parts, it is not a thing which can belong to God.

4. As for my own opinion, I have said more than once that I hold space to be something merely relative, as time is; that I hold it to be an order of co-existences as time is an order of successions. For space denotes, in terms of possibility, an order of things which exist at the same time, considered as existing together, without inquiring into their particular manner of existing. And when many things are seen together, one perceives that order of things among themselves.

5. I have many demonstrations to confute the fancy of those who take space to be a substance or at least an absolute being. But I shall only use, at the present, one demonstration, which the author here gives me occasion to insist upon. I say, then, that if space was an absolute being, there would something happen for which it would be impossible there should be a sufficient reason. Which is against my axiom. And I can prove it thus. Space is something absolutely uniform, and, without the things placed in it, one point of space does not absolutely differ in any respect whatsoever from another point of space. Now from hence it follows (supposing space to be something in itself, besides the order of bodies among themselves) that 'tis impossible there should be a reason why God,

preserving the same situations of bodies among themselves, should have placed them in space after one certain particular manner and not otherwise; why everything was not placed the quite contrary way, for instance, by changing east into west. But if space is nothing else but that order or relation, and is nothing at all without bodies but the possibility of placing them, then those two states, the one such as it now is, the other supposed to be the quite contrary way, would not at all differ from one another. Their difference therefore is only to be found in our chimerical supposition of the reality of space in itself. But in truth the one would exactly be the same thing as the other, they being absolutely indiscernible, and consequently there is no room to inquire after a reason of the preference of the one to the other.

6. The case is the same with respect to time. Supposing anyone should ask why God did not create everything a year sooner, and the same person should infer from thence that God has done something concerning which 'tis not possible there should be a reason why he did it so and not otherwise; the answer is that his inference would be right if time was anything distinct from things existing in time. For it would be impossible there should be any reason why things should be applied to such particular instants rather than to others, their succession continuing the same. But then the same argument proves that instants, considered without the things, are nothing at all and that they consist only in the successive order of things, which order remaining the same, one of the two states, viz., that of a supposed anticipation, would not at all differ, nor could be discerned from the other which now is.

7. It appears from what I have said that my axiom has not been well understood and that the author denies it though he seems to grant it. 'Tis true, says he, that there is nothing without a sufficient reason why it is, and why it is thus rather than otherwise, but he adds that this sufficient reason is often the simple or mere will of God—as when it is asked why matter was not placed otherwise in space, the same situations of bodies among themselves being

preserved. But this is plainly maintaining that God wills something without any sufficient reason for his will, against the axiom or the general rule of whatever happens. This is falling back into the loose indifference which I have confuted at large and showed to be absolutely chimerical even in creatures and contrary to the wisdom of God, as if he could operate without acting by reason.

8. The author objects against me that, if we don't admit this simple and mere will, we take away from God the power of choosing and bring in a fatality. But the quite contrary is true. I maintain that God has the power of choosing, since I ground that power upon the reason of a choice agreeable to his wisdom. And 'tis not this fatality (which is only the wisest order of providence) but a blind fatality or necessity void of all wisdom and choice which we ought to avoid.

9. I had observed that, by lessening the quantity of matter, the quantity of objects upon which God may exercise his goodness will be lessened. The author answers that instead of matter there are other things in the void space on which God may exercise his goodness. Be it so, though I don't grant it, for I hold that every created substance is attended with matter. However, let it be so; I answer that more matter was consistent with those same things, and consequently the said objects will be still lessened. The instance of a greater number of men or animals is not to the purpose, for they would fill up place in exclusion of other things.

10. It will be difficult to make me believe that sensorium does not, in its usual meaning, signify an organ of sensation. See the words of Rudolphus Goclenius in his *Dictionarium philosophicum* under *sensiterium.* "Barbarum Scholasticorum," says he, "qui interdum sunt simae Graecorum. Hi dicunt ἀιθητήριον. Ex quo illi facerunt *sensiterium* pro sensorio, id est, organo sensationis."[410]

11. The mere presence of a substance, even an animated one, is not sufficient for perception. A blind man, and even a man whose thoughts are wandering, does not see. The author must explain how the soul perceives what is without itself.

12. God is not present to things by situation but by essence; his presence is manifest by his immediate operation. The presence of the soul is quite of another nature. To say that it is diffused all over the body is to make it extended and divisible. To say it is, the whole of it, in every part of the body is to make it divided from itself. To fix it to a point, to diffuse it all over many points, are only abusive expressions, idola tribus.

13. If active force should diminish in the universe by the natural laws which God has established, so that there should be need for him to give a new impression in order to restore that force, like an artist's mending the imperfections of his machine, the disorder would not only be with respect to us but also with respect to God himself. He might have prevented it and taken better measures to avoid such an inconvenience, and therefore, indeed, he has actually done it.

14. When I said that God has provided remedies beforehand against such disorders, I did not say that God suffers disorders to happen and then finds remedies for them but that he has found a way beforehand to prevent any disorders happening.

15. The author strives in vain to criticize my expression that God is intelligentia supramundana. To say that God is above the world is not denying that he is in the world.

16. I never gave any occasion to doubt but that God's conservation is an actual preservation and continuation of the beings, powers, orders, dispositions, and motions of all things, and I think I have perhaps explained it better than many others. But, says the author, this is all I contended for. To this I answer, your humble servant for that, Sir. Our dispute consists in many other things. The question is whether God does not act in the most regular and most perfect manner; whether his machine is liable to disorder, which he is obliged to mend by extraordinary means; whether the will of God can act without reason; whether space is an absolute being; also concerning the nature of miracles; and many such things, which make a wide difference between us.

17. Divines will not grant the author's position against me, viz., that there is no difference, with respect to God, between natural and supernatural; and it will be still less approved by most philosophers. There is a vast difference between these two things, but it plainly appears it has not been duly considered. That which is supernatural exceeds all the powers of creatures. I shall give an instance which I have often made use of with good success. If God would cause a body to move free in the ether round about a certain fixed center, without any other creature acting upon it, I say it could not be done without a miracle, since it cannot be explained by the nature of bodies. For a free body does naturally recede from a curve in the tangent. And therefore I maintain that the attraction of bodies, properly so called, is a miraculous thing, since it cannot be explained by the nature of bodies.

VI

Clarke's Third Reply

1. This relates only to the signification of words. The definitions here given may well be allowed, and yet mathematical reasonings may be applied to physical and metaphysical subjects.

2. Undoubtedly nothing is without a sufficient reason why it is rather than not and why it is thus rather than otherwise. But in things in their own nature indifferent, mere will without anything external to influence it is alone that sufficient reason, as in the instance of God's creating or placing any particle of matter in one place rather than in another, when all places are originally alike. And the case is the same even though space were nothing real but only the mere order of bodies. For still it would be absolutely indifferent, and there could be no other reason but mere will why three equal particles should be placed or ranged in the order 1, 2, 3, rather than in the contrary order.[411] And therefore no argument can be drawn from this indifferency of all places to prove

that no space is real. For different spaces are really different or distinct one from another, though they be perfectly alike. And there is this evident absurdity in supposing space not to be real but to be merely the order of bodies—that, according to that notion, if the earth and sun and moon had been placed where the remotest fixed stars now are, provided they were placed in the same order and distance they now are with regard one to another, it would not only have been (as this learned author rightly says) la même chose, the same thing in effect, which is very true; but it would also follow that they would then have been in the same place too as they are now, which is an express contradiction.

The[412] ancients did not call all space which is void of bodies, but only extramundane space, by the name of imaginary space. The meaning of which is not that such space is not real but only that we are wholly ignorant what kinds of things are in that space. Those writers who by the word "imaginary" meant at any time to affirm that space was not real did not thereby prove that it was not real.

3. Space is not a being, an eternal and infinite being, but a property, or the consequence of the existence of a being infinite and eternal. Infinite space is immensity, but immensity is not God, and therefore infinite space is not God. Nor is there any difficulty in what is here alleged about space having parts. For infinite space is one, absolutely and essentially indivisible. And to suppose it parted is a contradiction in terms, because there must be space in the partition itself, which is to suppose it parted and yet not parted at the same time. The immensity or omnipresence of God is no more a dividing of his substance into parts than his duration or continuance of existing is a dividing of his existence into parts.[413] There is no difficulty here but what arises from the figurative abuse of the word "parts."

4. If space was nothing but the order of things coexisting, it would follow that, if God should remove in a straight line the whole material world entire, with any swiftness whatsoever, yet it would

always continue in the same place, and that nothing would receive any shock upon the most sudden stopping of that motion. And if time was nothing but the order of succession of created things, it would follow that, if God had created the world millions of ages sooner than he did, yet it would not have been created at all the sooner. Further, space and time are quantities, which situation and order are not.

5. The argument in this paragraph is that, because space is uniform or alike, and one part does not differ from another, therefore the bodies created in one place, if they had been created in another place (supposing them to keep the same situation with regard to each other), would still have been created in the same place as before, which is a manifest contradiction. The uniformity of space does indeed prove that there could be no (external) reason why God should create things in one place rather than in another. But does that hinder his own will from being to itself a sufficient reason of acting in any place, when all places are indifferent or alike, and there be good reason to act in some place?

6. The same reasoning takes place here as in the foregoing.

7 and 8. Where there is any difference in the nature of things, there the consideration of that difference always determines an intelligent and perfectly wise agent. But when two ways of acting are equally and alike good (as in the instances before mentioned), to affirm in such case that God cannot act at all, or that 'tis no perfection in him to be able to act, because he can have no external reason to move him to act in one way rather than the other, seems to be a denying God to have in himself any original principle or power of beginning to act, but that he must needs (as it were mechanically) be always determined by things extrinsic.

9. I suppose that determinate quantity of matter that is now in the world is the most convenient for the present frame of nature, or the present state of things, and that a greater (as well as a less) quantity of matter would have made the present frame of the world less convenient and consequently would not have been a greater object for God to have exercised his goodness upon.

10. The question is not what Goclenius, but what Sir Isaac Newton, means by the word "sensorium," when the debate is about the sense of Sir Isaac Newton's and not about the sense of Goclenius' book. If Goclenius takes the eye or ear or any other organ of sensation to be the sensorium, he is certainly mistaken. But when any writer expressly explains what he means by any term of art, of what use is it, in this case, to inquire in what different senses perhaps some other writers have sometimes used the same word? Scapula explains it by domicilium, the place where the mind resides.

11. The soul of a blind man does for this reason not see, because no images are conveyed (there being some obstruction in the way) to the sensorium where the soul is present. How the soul of a seeing man sees the images to which it is present, we know not. But we are sure it cannot perceive what it is not present to, because nothing can act or be acted upon where it is not.

12. God, being omnipresent, is really present to everything, essentially and substantially.[414] His presence manifests itself indeed by its operation, but it could not operate if it was not there. The soul is not omnipresent to every part of the body and therefore does not and cannot itself actually operate upon every part of the body but only upon the brain or certain nerves and spirits, which, by laws and communications of God's appointing, influence the whole body.

13 and 14. The active forces[415] which are in the universe diminishing themselves so as to stand in need of new impressions is no inconvenience, no disorder, no imperfection in the workmanship of the universe, but is the consequence of the nature of dependent things. Which dependency of things is not a matter that wants to be rectified. The case of a human workman making a machine is quite another thing, because the powers or forces by which the machine continues to move are altogether independent on the artificer.

15. The phrase intelligentia supramundana may well be allowed

as it is here explained. But, without this explication, the expression is very apt to lead to a wrong notion, as if God was not really and substantially present everywhere.

16. To the questions here proposed, the answer is that God does always act in the most regular and perfect manner, that there are no disorders in the workmanship of God, and that there is nothing more extraordinary in the alterations he is pleased to make in the frame of things than in his continuation of it; that in things in their own nature absolutely equal and indifferent the will of God can freely choose and determine itself without any external cause to impel it, and that 'tis a perfection in God to be able to do so; that space does not at all depend on the existence or order or situation of bodies. And as to the notion of miracles:

17. The question is not what [it] is that divines or philosophers usually allow or not allow but what reasons men allege for their opinions. If a miracle be that only which surpasses the power of all created beings, then for a man to walk on the water, or for the motion of the sun or the earth to be stopped, is no miracle, since none of these things require infinite power to effect them. For a body to move in a circle round a center in vacuo, if it be usual (as the planets moving about the sun), 'tis no miracle, whether it be effected immediately by God himself or mediately by any created power. But if it be unusual (as for a heavy body to be suspended and move so in the air), 'tis equally a miracle, whether it be effected immediately by God himself or mediately by any invisible created power. Lastly, if whatever arises not from, and is not explicable by, the natural powers of body be a miracle, then every animal motion whatsoever is a miracle. Which seems demonstrably to show that this learned author's notion of a miracle is erroneous.

VII

Leibniz's Fourth Letter

1. In things absolutely indifferent there is no (foundation for) choice, and consequently no election or will, since choice must be founded on some reason or principle.

2. A mere will without any motive is a fiction, not only contrary to God's perfection but also chimerical and contradictory, inconsistent with the definition of the will, and sufficiently confuted in my Theodicy.

3. 'Tis a thing indifferent to place three bodies, equal and perfectly alike, in any order whatsoever, and consequently they will never be placed in any order by him who does nothing without wisdom. But then, he being the author of things, no such things will be produced by him at all, and consequently there are no such things in nature.

4. There is no such thing as two individuals indiscernible from each other. An ingenious gentleman of my acquaintance, discoursing with me in the presence of Her Electoral Highness, the Princess Sophia, in the garden of Herrenhausen, thought he could find two leaves perfectly alike. The princess defied him to do it, and he ran all over the garden a long time to look for some; but it was to no purpose. Two drops of water or milk, viewed with a microscope, will appear distinguishable from each other. This is an argument against atoms, which are confuted, as well as a vacuum, by the principles of true metaphysics.

5. These great principles of sufficient reason and of the identity of indiscernibles change the state of metaphysics. That science becomes real and demonstrative by means of these principles, whereas before it did generally consist in empty words.

6. To suppose two things indiscernible is to suppose the same thing under two names. And therefore to suppose that the universe could have had at first another position of time and place than that

which it actually had, and yet that all the parts of the universe should have had the same situation among themselves as that which they actually had—such a supposition, I say, is an impossible fiction.

7. The same reason which shows that extramundane space is imaginary proves that all empty space is an imaginary thing, for they differ only as greater and less.

8. If space is a property or attribute, it must be the property of some substance. But what substance will that bounded empty space be an affection or property of, which the persons I am arguing with suppose to be between two bodies?

9. If infinite space is immensity, finite space will be the opposite to immensity, that is, 'twill be mensurability, or limited extension. Now extension must be the affection of something extended. But if that space be empty, it will be an attribute without a subject, an extension without anything extended. Wherefore, by making space a property, the author falls in with my opinion, which makes it an order of things and not anything absolute.

10. If space is an absolute reality, far from being a property or an accident opposed to substance, it will have a greater reality than substances themselves. God cannot destroy it, nor even change it in any respect. It will be not only immense in the whole but also immutable and eternal in every part. There will be an infinite number of eternal things besides God.

11. To say that infinite space has no parts is to say that it does not consist of finite spaces and that infinite space might subsist though all finite space should be reduced to nothing. It would be as if one should say, in the Cartesian supposition of a material extended unlimited world, that such a world might subsist, though all the bodies of which it consists should be reduced to nothing.

12. The author attributes parts to space, on page 9 of the third edition of his Defense of the Argument against Mr. Dodwell, and makes them inseparable one from another. But on page 30 of his Second Defense he says they are parts improperly so called—which may be understood in a good sense.

13. To say that God can cause the whole universe to move forward in a right line or in any other line, without making otherwise any alteration in it, is another chimerical supposition. For two states indiscernible from each other are the same state, and consequently 'tis a change without any change. Besides, there is neither rhyme nor reason in it. But God does nothing without reason, and 'tis impossible that there should be any here. Besides, it would be *agendo nihil agere*, as I have just now said, because of the indiscernibility.

14. These are *idola tribus*, mere chimeras, and superficial imaginations. All this is only grounded upon the supposition that imaginary space is real.

15. It is a like fiction (that is), an impossible one, to suppose that God might have created the world some millions of years sooner. They who run into such kind of fictions can give no answer to one that should argue for the eternity of the world. For since God does nothing without reason, and no reason can be given why he did not create the world sooner, it will follow either that he has created nothing at all or that he created the world before any assignable time, that is, that the world is eternal. But when once it has been shown that the beginning, whenever it was, is always the same thing, the question why it was not otherwise ordered becomes needless and insignificant.

16. If space and time were anything absolute, that is, if they were anything else besides certain orders of things, then indeed my assertion would be a contradiction. But since it is not so, the hypothesis (that space and time are anything absolute) is contradictory, that is, 'tis an impossible fiction.

17. And the case is the same as in geometry, where by the very supposition that a figure is greater than it really is, we sometimes prove that it is not greater. This indeed is a contradiction, but it lies in the hypothesis, which appears to be false for that very reason.

18. Space being uniform, there can be neither any external nor

internal reason by which to distinguish its parts and to make any choice among them. For any external reason to discern between them can only be grounded upon some internal one. Otherwise we should discern what is indiscernible or choose without discerning. A will without reason would be the chance of the Epicureans. A God who should act by such a will would be a God only in name. The cause of these errors proceeds from want of care to avoid what derogates from the divine perfections.

19. When two things which cannot both be together are equally good, and neither in themselves nor by their combination with other things has one the advantage over the other, God will produce neither of them.

20. God is never determined by external things but always by what is in himself, that is, by his knowledge of things before anything exists without himself.

21. There is no possible reason that can limit the quantity of matter, and therefore such limitation can have no place.

22. And supposing an arbitrary limitation of the quantity of matter, one could always add something without detracting from the perfection of the things which are already there, and consequently something must always be added in order to act according to the principle of the perfection of the divine operations.

23. And therefore it cannot be said that the present quantity of matter is the fittest for the present constitution of things. And supposing it were, it would follow that this present constitution of things would not be the fittest absolutely if it hinders God from using more matter. It were therefore better to choose another constitution of things, capable of something more.

24. I should be glad to see a passage of any philosopher who takes sensorium in any other sense than Goclenius does.[416]

25. If Scapula says that sensorium is the place in which the understanding resides, he means by it the organ of internal sensation. And therefore he does not differ from Goclenius.

26. Sensorium has always signified the organ of sensation.

The pineal gland would be, according to Descartes, the sensorium in the above-mentioned sense of Scapula.

27. There is hardly any expression less proper upon this subject than that which makes God to have a sensorium. It seems to make God the soul of the world. And it will be a hard matter to put a justifiable sense upon this word, according to the use Sir Isaac Newton makes of it.

28. Though the question be about the sense put upon that word by Sir Isaac Newton, and not by Goclenius, yet I am not to blame for quoting the philosophical dictionary of that author, because the design of dictionaries is to show the use of words.

29. God perceives things in himself. Space is the place of things and not the place of God's ideas, unless we look upon space as something that makes a union between God and things in imitation of the imagined union between the soul and the body, which would still make God the soul of the world.

30. And indeed the author is much in the wrong when he compares God's knowledge and operation with the knowledge and operation of souls. The soul knows things because God has put into it a principle representative of things without. But God knows things because he produces them continually.

31. The soul does not act upon things, according to my opinion, any otherwise than because the body adapts itself to the desires of the soul, by virtue of the harmony which God has pre-established between them.

32. But they who fancy that the soul can give a new force to the body, and that God does the same in the world in order to mend the imperfections of his machine, make God too much like the soul by ascribing too much to the soul and too little to God.

33. For none but God can give a new force to nature, and he does it only supernaturally. If there was need for him to do it in the natural course of things, he would have made a very imperfect work. At that rate, he would be with respect to the world what the soul, in the vulgar notion, is with respect to the body.

34. Those who undertake to defend the vulgar opinion concerning the soul's influence over the body, by instancing in God's operating on things external, make God still too much like a soul of the world. To which I add that the author's affecting to find fault with the words intelligentia supramundana seems also to incline that way.

35. The images with which the soul is immediately affected are within itself, but they correspond to those of the body. The presence of the soul is imperfect and can only be explained by that correspondence. But the presence of God is perfect and manifested by his operation.

36. The author wrongly supposes against me that the presence of the soul is connected with its influence over the body, for he knows I reject that influence.

37. The soul's being diffused through the brain is no less inexplicable than its being diffused through the whole body. The difference is only in more and less.

38. They who fancy that active force lessens of itself in the world do not well understand the principal laws of nature and the beauty of the works of God.

39. How will they be able to prove that this defect is a consequence of the dependence of things?

40. The imperfection of our machines, which is the reason why they want to be mended, proceeds from this very thing, that they do not sufficiently depend upon the workman. And therefore the dependence of nature upon God, far from being the cause of such an imperfection, is rather the reason why there is no such imperfection in nature, because it depends so much upon an artist who is too perfect to make a work that wants to be mended. 'Tis true that every particular machine of nature is in some measure liable to be disordered, but not the entire universe, which cannot diminish in perfection.

41. The author contends that space does not depend upon the situation of bodies. I answer: 'Tis true; it does not depend upon

such or such a situation of bodies, but it is that order which renders bodies capable of being situated, and by which they have a situation among themselves when they exist together, as time is that order with respect to their successive position. But if there were no creatures, space and time would be only in the ideas of God.

42. The author seems to acknowledge here that his notion of a miracle is not the same with that which divines and philosophers usually have. It is therefore sufficient for my purpose that my adversaries are obliged to have recourse to what is commonly called a miracle.[417]

43. I am afraid the author, by altering the sense commonly put upon the word "miracle," will fall into an inconvenient opinion. The nature of a miracle does not at all consist in usefulness or unusefulness, for then monsters would be miracles.

44. There are miracles of an inferior sort which an angel can work. He can, for instance, make a man walk upon the water without sinking. But there are miracles which none but God can work, they exceeding all natural powers. Of which kind are creating and annihilating.

45. 'Tis also a supernatural thing that bodies should attract one another at a distance without any intermediate means and that a body should move around without receding in the tangent, though nothing hinder it from so receding. For these effects cannot be explained by the nature of things.

46. Why should it be impossible to explain the motion of animals by natural forces? Though, indeed, the beginning of animals is no less inexplicable by natural forces than the beginning of the world.

P.S. All those who maintain a vacuum are more influenced by imagination than by reason. When I was a young man, I also gave in to the notion of a vacuum and atoms, but reason brought me into the right way. It was a pleasing imagination. Men carry their inquiries no further than those two things: they (as it were) nail down their thoughts to them; they fancy they have found out the first elements of things, a non plus ultra. We would have nature to go no further and to be finite as our minds are; but this is being ignorant of the greatness and majesty of the author of things. The least corpuscle is actually subdivided in infinitum and contains a world of other creatures which would be wanting in the universe if that corpuscle was an atom, that is, a body of one entire piece without subdivision. In like manner, to admit a vacuum in nature is ascribing to God a very imperfect work; 'tis violating the grand principle of the necessity of a sufficient reason, which many have talked of without understanding its true meaning; as I have lately shown in proving, by that principle, that space is only an order of things, as time also is, and not at all an absolute being. To omit many other arguments against a vacuum and atoms, I shall here mention those which I ground upon God's perfection and upon the necessity of a sufficient reason. I lay it down as a principle that every perfection which God could impart to things without derogating from their other perfections has actually been imparted to them. Now let us fancy a space wholly empty. God could have placed some matter in it without derogating in any respect from all other things; therefore he hath actually placed some matter in that space; therefore there is no space wholly empty; therefore all is full. The same argument proves that there is no corpuscle but what is subdivided. I shall add another argument grounded upon the necessity of a sufficient reason. 'Tis impossible there should be any principle to determine what proportion of matter there ought to be, out of all the possible degrees from a plenum to a vacuum, or from a vacuum to a plenum. Perhaps it will be said that the one should be equal to the other, but, because matter is more perfect than a vacuum, reason requires that a geometrical proportion should be observed and that there should be as much more matter than vacuum, as the former deserves to have the preference before the latter. But then there must be no vacuum at all, for the perfection of matter is to that of a vacuum as something to nothing. And the case is the same with atoms: What reason can anyone assign for confining nature in the progression of subdivision? These are fictions merely arbitrary and unworthy of true philosophy. The reasons alleged for a vacuum are mere sophisms.

VIII

Clarke's Fourth Reply

1 and 2. This notion leads to universal necessity and fate, by supposing that motives have the same relation to the will of an intelligent agent as weights have to a balance, so that, of two things absolutely indifferent, an intelligent agent can no more choose either than a balance can move itself when the weights on both sides are equal. But the difference lies here. A balance is no agent but is merely passive and acted upon by the weights, so that, when the weights are equal, there is nothing to move it. But intelligent beings are agents—not passive, in being moved by motives as a balance is by weights, but they have active powers and do move themselves, sometimes upon the view of strong motives, sometimes upon weak ones, and sometimes where things are absolutely indifferent. In which latter case, there may be very good reason to act, though two or more ways of acting may be absolutely indifferent. This learned writer always supposes the contrary as a principle but gives no proof of it either from the nature of things or the perfections of God.

3 and 4. This argument, if it was true, would prove that God neither has created nor can possibly create any matter at all. For the perfectly solid parts of all matter, if you take them of equal figure and dimensions (which is always possible in supposition), are exactly alike, and therefore it would be perfectly indifferent if they were transposed in place; and consequently it was impossible (according to this learned author's argument) for God to place

them in those places wherein he did actually place them at the creation, because he might as easily have transposed their situation. 'Tis very true that no two leaves, and perhaps no two drops of water, are exactly alike, because they are bodies very much compounded. But the case is very different in the parts of simple solid matter. And even in compounds, there is no impossibility for God to make two drops of water exactly alike. And if he should make them exactly alike, yet they would never the more become one and the same drop of water because they were alike. Nor would the place of the one be the place of the other, though it was absolutely indifferent which was placed in which place. The same reasoning holds likewise concerning the original determination of motion, this way or the contrary way.

5 and 6. Two things by being exactly alike do not cease to be two. The parts of time are as exactly alike to each other as those of space; yet two points of time are not the same point of time, nor are they two names of only the same point of time. Had God created the world but this moment, it would not have been created at the time it was created. And if God has made (or can make) matter finite in dimensions, the material universe must consequently be by its nature movable, for nothing that is finite is immovable. To say therefore that God could not have altered the time or place of the existence of matter is making (this) to be necessarily infinite and eternal and reducing all things to necessity and fate.

7. Extramundane space (if the material world be finite in its dimensions) is not imaginary but real. Nor are void spaces in the world merely imaginary. In an exhausted receiver, though rays of light, and perhaps some other matter, be there in exceeding small quantity, yet the want of resistance plainly shows that the greatest part of that space is void of matter. For subtleness or fineness of matter cannot be the cause of want of resistance. Quicksilver is as subtle and consists of as fine parts and as fluid as water and yet makes more than ten times the resistance, which resistance arises therefore from the quantity and not from the grossness of the matter.

8. Space void of body is the property of an incorporeal substance. Space is not bounded by bodies but exists equally within and without bodies. Space is not inclosed between bodies, but bodies, existing in unbounded space, are themselves only terminated by their own dimensions.

9. Void space is not an attribute without a subject, because by void space we never mean space void of everything but void of body only. In all void space God is certainly present, and possibly many other substances which are not matter, being neither tangible nor objects of any of our senses.

10. Space is not a substance but a property. And if it be a property of that which is necessary, it will consequently (as all other properties of that which is necessary must do) exist more necessarily (though it be not itself a substance) than those substances themselves which are not necessary. Space is immense and immutable and eternal, and so also is duration. Yet it does not at all from hence follow that anything is eternal hors de dieu. For space and duration are not hors de dieu but are caused by and are immediate and necessary consequences of his existence. And without them his eternity and ubiquity (or omnipresence) would be taken away.[418]

11 and 12. Infinites are composed of finites in no other sense than as finites are composed of infinitesimals. In what sense space has or has not parts has been explained before (Paper 3, Sec. 3). Parts in the corporeal sense of the word are separable, compounded, ununited, independent on and movable from each other. But infinite space, though it may by us be partially apprehended, that is, may in our imagination be conceived as composed of parts, yet those parts (improperly so called) being essentially indiscerpible and immovable from each other, and not partable without an express contradiction in terms (see above, Paper 3, Sec. 3), space consequently is in itself essentially one and absolutely indivisible.

13. If the world be finite in dimensions, it is movable by the

power of God, and therefore my argument drawn from that movableness is conclusive. Two places, though exactly alike, are not the same place. Nor is the motion or rest of the universe the same state, any more than the motion or rest of a ship is the same state, because a man shut up in the cabin cannot perceive whether the ship sails or not, so long as it moves uniformly. The motion of the ship, though the man perceives it not, is a real different state and has real different effects and upon a sudden stop would have other real effects; and so likewise would an indiscernible motion of the universe. To this argument no answer has ever been given. It is largely insisted on by Sir Isaac Newton in his *Mathematical Principles,* Definition 8, where from the consideration of the properties, causes, and effects of motio he shows the difference between real motion, or a body's being carrie from one part of space to another, and relative motion, which is merely a change of the order or situation of bodies with respect to each other. This argument is a mathematical one, showing from real effects that there may be real motion where there is relative, and relative motion where there is none real, and is not to be answered by barely asserting the contrary.

14. The reality of space is not a supposition but is proved by the foregoing arguments, to which no answer has been given. Nor is any answer given to that other argument, that space and time are quantities, which situation and order are not.

15. It was no impossibility for God to make the world sooner or later than he did, nor is it all impossible for him to destroy it sooner or later than it shall actually be destroyed. As to the notion of the world's eternity, they who suppose matter and space to be the same must indeed suppose the world to be not only infinite and eternal but necessarily so; even as necessarily as space and duration, which depend not on the will but on the existence of God. But they who believe that God created matter in what quantity, and at what particular time, and in what particular spaces he pleased are here under no difficulty. For the wisdom of God may have very good reasons for creating this world at that par-

ticular time he did and may have made other kinds of things before this material world began and may make other kinds of things after this world is destroyed.

16 and 17. That space and time are not the mere order of things but real quantities (which order and situation are not) has been proved above (see Paper 3, Sec. 4, and in this paper, Sec. 13), and no answer yet given to those proofs. And till an answer be given to those proofs, this learned author's assertion is (by his own confession in this place) a contradiction.

18. The uniformity of all the parts of space is no argument against God's acting in any part after what manner he pleases. God may have good reasons to create finite beings, and finite beings can be put in particular places. And, all things being originally alike, even though place were nothing else but the situation of bodies, God's placing one cube of matter behind another equal cube of matter rather than the other behind that is a choice in no wise unworthy of the perfections of God, though both these situations be perfectly equal, because there may be very good reasons why both the cubes should exist, and they cannot exist but in one or other of equally reasonable situations. The Epicurean chance is not a choice of will but a blind necessity of fate.

19. This argument (as I now observed, Sec. 3), if it proves anything, proves that God neither did nor can create any matter at all, because the situation of equal and similar parts of matter could not but be originally indifferent, as was also the original determination of their motions, this way or the contrary way.

20. What this tends to prove with regard to the argument before us, I understand not.

21. That God cannot limit the quantity of matter is an assertion of too great consequence to be admitted without proof. If he cannot limit the duration of it neither, then the material world is both infinite and eternal, necessarily and independently upon God.

22 and 23. This argument (if it were good) would prove that whatever God can do he cannot but do, and consequently that he

cannot but make everything infinite and everything eternal. Which is making him no governor at all but a merely necessary agent, that is, indeed, no agent at all but mere fate and nature and necessity.

24-28. Concerning the use of the word "sensory" (though Sir Isaac Newton says only "as it were the sensory"), enough has been said in my third paper, Section 10, and second paper, Section 3, and first paper, Section 3.

29. Space is the place of all things and of all ideas, just as duration is the duration of all things and of all ideas. That this has no tendency to make God the soul of the world, see above in Paper 2, Section 12. There is no union between God and the world. The mind of man might with greater propriety be styled the soul of the images of things which it perceives than God can be styled the soul of the world, to which he is present throughout and acts upon it as he pleases, without being acted upon by it. Though this answer was given before (Paper 2, Sec. 12), yet the same objection is repeated again and again, without taking any notice of the answer.

30. What is meant by "a representative principle," I understand not. The soul discerns things by having the images of things conveyed to it through the organs of sense; God discerns things by being present to and in the substances of the things themselves. Not by producing them continually (for he rests now from his work of creation) but by being continually omnipresent to everything which he created at the beginning.

31. That the soul should not operate upon the body, and yet the body, by a mere mechanical impulse of matter, conform itself to the will of the soul in all the infinite variety of spontaneous animal motion, is a perpetual miracle. Pre-established harmony is a mere word or term of art and does nothing toward explaining the cause of so miraculous an effect.

32. To suppose that in spontaneous animal motion the soul gives no new motion or impression to matter but that all sponta-

neous animal motion is performed by mechanical impulse of matter is reducing all things to mere fate and necessity. God's acting in the world upon everything after what manner he pleases, without any union and without being acted upon by anything, shows plainly the difference between an omnipresent governor and an imaginary soul of the world.

33. Every action is (in the nature of things) the giving of a new force to the thing acted upon. Otherwise 'tis not really action but mere passiveness, as in the case of all mechanical and inanimate communications of motion. If therefore the giving a new force be supernatural, then every action of God is supernatural, and he is quite excluded from the government of the natural world. And either every action of man is supernatural or else man is as mere a machine as a clock.

34 and 35. The difference between the true notion of God and that of a soul of the world has been before shown. Paper 2, Section 12, and in this paper, Sections 29 and 32.

36. This has been answered just above, Section 31.

37. The soul is not diffused through the brain but is present to that particular place, which is the sensorium.

38. This is a bare assertion without proof. Two bodies void of elasticity meeting together with equal contrary forces both lose their motion. And Sir Isaac Newton has given a mathematical instance (p. 341 of the Latin edition of his Optics) wherein motion is continually diminishing and increasing in quantity, without any communication thereof to other bodies.[419]

39. This is no defect as is here supposed, but 'tis the just and proper nature of inert matter.

40. This argument (if it be good) proves that the material world must be infinite and that it must have been from eternity and must continue to eternity; and that God must always have created as many men and as many of all other things as 'twas possible for him to create and for as long a time also as it was possible for him to do it.

41. What the meaning of these words is: "an order (or situation) which renders bodies capable of being situated," I understand not. It seems to me to amount to this—that situation is the cause of situation. That space is not merely the order of bodies has been shown before, Paper 3, Sections 2 and 4. And that no answer has been given to the argument there offered has been shown in this paper, Sections 13 and 14. Also that time is not merely the order of things succeeding each other is evident because the quantity of time may be greater or less, and yet that order continue the same. The order of things suceeding each other in time is not time itself, for they may succeed each other faster or slower in the same order of succession but not in the same time. If no creatures existed, yet the ubiquity of God and the continuance of his existence would make space and duration to be exactly the same as they are now.

42. This is appealing from reason to vulgar opinion, which philosophers should not do, because it is not the rule of truth.

43. Unusualness is necessarily included in the notion of a miracle. For otherwise there is nothing more wonderful, nor that requires greater power to effect, than some of those things we call natural, such as the motions of the heavenly bodies, the generation and formation of plants and animals, etc. Yet these are for this only reason not miracles, because they are common. Nevertheless, it does not follow that everything which is unusual is therefore a miracle. For it may be only the irregular and more rare effect of usual causes, of which kind are eclipses, monstrous births, madness in men, and innumerable things which the vulgar call prodigies.

44. This is a concession of what I alleged. And yet 'tis contrary to the common opinion of divines to suppose that an angel can work a miracle.

45. That one body should attract another sans aucun moyen is indeed not a miracle but a contradiction. For 'tis supposing something to act where it is not. But the moyen by which two bodies attract each other may be invisible and intangible, and of a different

nature from mechanism, and yet, acting regularly and constantly, may well be called natural, being much less wonderful than animal motion, which yet is never called a miracle.

46. If the word "natural forces" means here mechanical, then all animals, and even men, are as mere machines as a clock. But if the word does not mean mechanical forces, then gravitation may be effected by regular and natural powers, though they be not mechanical.[420]

IX

Leibniz's Fifth Paper

To Sections 1 and 2 of the Preceding Paper.

1. I shall at this time make a larger answer to clear the difficulties and to try whether the author be willing to hearken to reason and to show that he is a lover of truth, or whether he will only cavil without clearing anything.

2. He often endeavors to impute to me necessity and fatality, though perhaps no one has better and more fully explained than I have done in my *Theodicy* the true difference between liberty, contingency, spontaneity, on the one side, and absolute necessity, chance, coaction, on the other.[421] I know not yet whether the author does this because he will do it, whatever I may say, or whether he does it (supposing him sincere in those imputations) because he has not yet duly considered my opinions. I shall soon find what I am to think of it, and I shall take my measures accordingly.

3. It is true that *reason* in the mind of a wise being, and *motives* in any mind whatsoever, do that which answers to the effect produced by weights in a balance. The author objects that this notion leads to necessity and fatality. But he says so without proving it and without taking notice of the explications I have formerly given in order to remove the difficulties that may be raised upon that head.

4. He seems also to play with equivocal terms. There are necessities which ought to be admitted. For we must distinguish between an absolute and a hypothetical necessity. We must also distinguish between a necessity which takes place because the opposite implies a contradiction (which necessity is called logical, metaphysical, or mathematical) and a necessity which is moral, whereby a wise being chooses the best, and every mind follows the strongest inclination.

5. Hypothetical necessity is that which the supposition or hypothesis of God's foresight and preordination lays upon future contingents. And this must needs be admitted, unless we deny, as the Socinians do, God's foreknowledge of future contingents and his providence which regulates and governs every particular thing.

6. But neither that foreknowledge nor that preordination derogate from liberty. For God, being moved by his supreme reason to choose, among many series of things or worlds possible, that in which free creatures should take such or such resolutions, though not without his concourse, has thereby rendered every event certain and determined once for all, without derogating thereby from the liberty of those creatures that simple decree of choice, not at all changing but only actualizing their free natures which he saw in his ideas.[422]

7. As for moral necessity, this also does not derogate from liberty. For when a wise being, and especially God who has supreme wisdom, chooses what is best, he is not the less free upon that account; on the contrary, it is the most perfect liberty not to be hindered from acting in the best manner. And when any other chooses according to the most apparent and the most strongly inclining good, he imitates therein the liberty of a truly wise being, in proportion to his disposition. Without this, the choice would be a blind chance.

8. But good, either true or apparent—in a word, the motive—inclines without necessitating, that is, without imposing an absolute necessity. For when God (for instance) chooses the best, what

he does not choose, and is inferior in perfection, is nevertheless possible. But if what he chooses was absolutely necessary, any other way would be impossible, which is against the hypothesis. For God chooses among possibles, that is, among many ways none of which implies a contradiction.

9. But to say that God can only choose what is best, and to infer from thence that what he does not choose is impossible, this, I say, is confounding of terms; 'tis blending power and will, metaphysical necessity and moral necessity, essences and existences. For what is necessary is so by its essence, since the opposite implies a contradiction. But a contingent which exists owes its existence to the principle of what is best, which is a sufficient reason for the existence of things. And therefore I say that motives incline without necessitating and that there is a certainty and infallibility but not an absolute necessity in contingent things. Add to this what will be said hereafter, in Nos. 73 and 76.

10. And I have sufficiently shown in my *Theodicy* that this moral necessity is a good thing, agreeable to the divine perfection, agreeable to the great principle or ground of existences, which is that of the want of a sufficient reason, whereas absolute and metaphysical necessity depends upon the other great principle of our reasonings, viz., that of essences, that is, the principle of identity or contradiction. For what is absolutely necessary is the only possible way, and its contrary implies a contradiction.

11. I have also shown that our will does not always exactly follow the practical understanding, because it may have or find reasons to suspend its resolution till a further examination.[423]

12. To impute to me after this the notion of an absolute necessity, without having anything to say against the reasons which I have just now alleged and which go to the bottom of things, perhaps beyond what is to be seen elsewhere—this, I say, will be an unreasonable obstinacy.

13. As to the notion of fatality which the author lays also to my charge, this is another ambiguity. There is a fatum *Mahome-*

tanum, a fatum Stoicum, and a fatum Christianum.[424] The Turkish fate will have an effect to happen even though its cause should be avoided, as if there was an absolute necessity. The Stoical fate will have a man to be quiet because he must have patience whether he will or not, since 'tis impossible to resist the course of things. But 'tis agreed that there is a fatum Christianum, a certain destiny of everything, regulated by the foreknowledge and providence of God. Fatum is derived from fari, that is, "to pronounce," "to decree," and in its right sense it signifies the decree of providence. And those who submit to it through a knowledge of the divine perfections, whereof the love of God is a consequence, have not only patience, like the heathen philosophers, but are also contented with what is ordained by God, knowing he does everything for the best and not only for the greatest good in general but also for the greatest particular good of those who love him.

14. I have been obliged to enlarge in order to remove ill-grounded imputations once for all, as I hope I shall be able to do by these explications, so as to satisfy equitable persons. I shall now come to an objection raised here against my comparing the weights of a balance with the motives of the will. 'Tis objected that a balance is merely passive and moved by the weights, whereas agents intelligent, and endowed with will, are active. To this I answer that the principle of the want of a sufficient reason is common both to agents and patients—they want a sufficient reason of their action as well as of their passion. A balance not only does not act when it is equally pulled on both sides, but the equal weights likewise do not act when they are in an equilibrium, so that one of them cannot go down without the other's rising up as much.

15. It must also be considered that, properly speaking, motives do not act upon the mind as weights do upon a balance, but 'tis rather the mind that acts by virtue of the motives, which are its dispositions to act. And therefore to pretend, as the author does here, that the mind prefers sometimes weak motives to strong

ones, and even that it prefers that which is indifferent before motives; this, I say, is to divide the mind from the motives as if they were without the mind as the weight is distinct from the balance and as if the mind had, besides motives, other dispositions to act by virtue of which it could reject or accept the motives. Whereas, in truth, the motives comprehend all the dispositions which the mind can have to act voluntarily, for they include not only the reasons but also the inclinations arising from passions or other preceding impressions. Wherefore if the mind should prefer a weak inclination to a strong one, it would act against itself and otherwise than it is disposed to act. Which shows that the author's notions, contrary to mine, are superficial and appear to have no solidity in them when they are well considered.

16. To assert also that the mind may have good reasons to act when it has no motives and when things are absolutely indifferent, as the author explains himself here; this, I say, is a manifest contradiction. For if the mind has good reasons for taking the part it takes, then the things are not indifferent to the mind.

17. And to affirm that the mind will act when it has reasons to act, even though the ways of acting were absolutely indifferent; this, I say, is to speak again very superficially and in a manner that cannot be defended. For a man never has a sufficient reason to act when he has not also a sufficient reason to act in a certain particular manner, every action being individual and not general, nor abstract from its circumstances, but always needing some particular way of being put into execution. Wherefore when there is a sufficient reason to do any particular thing, there is also a sufficient reason to do it in a certain particular manner, and consequently several manners of doing it are not indifferent. As often as a man has sufficient reasons for a single action, he has also sufficient reasons for all its requisites. See also what I shall say below, No. 66.

18. These arguments are very obvious, and 'tis very strange to charge me with advancing my principle of the want of a suffi-

cient reason without any proof drawn either from the nature of things or from the divine perfections. For the nature of things requires that every event should have beforehand its proper conditions, requisites, and dispositions, the existence whereof makes the sufficient reason of such event.

19. And God's perfection requires that all his actions should be agreeable to his wisdom and that it may not be said of him that he has acted without reason or even that he has preferred a weaker reason before a stronger.

20. But I shall speak more largely at the conclusion of this paper concerning the solidity and importance of this great principle of the want of a sufficient reason in order to every event, the overthrowing of which principle would overthrow the best part of all philosophy. 'Tis therefore very strange that the author should say I am herein guilty of a *petitio principii*, and it plainly appears he is desirous to maintain indefensible opinions, since he is reduced to deny that great principle which is one of the most essential principles of reason.

To Sections 3 and 4.

21. It must be confessed that, though this great principle has been acknowledged, yet it has not been sufficiently made use of. Which is in great measure the reason why the *prima philosophia* has not been hitherto so fruitful and demonstrative as it should have been. I infer from that principle, among other consequences, that there are not in nature two real, absolute beings, indiscernible from each other, because, if there were, God and nature would act without reason in ordering the one otherwise than the other; and that therefore God does not produce two pieces of matter perfectly equal and alike. The author answers this conclusion without confuting the reason of it, and he answers with a very weak objection. "That argument," says he, "if it was good, would prove that it would be impossible for God to create any matter at all. For the perfectly solid parts of matter, if we take them of equal figure and dimensions (which is always possible in supposi-

tion), would be exactly alike." But 'tis a manifest *petitio principii* to suppose that perfect likeness, which, according to me, cannot be admitted. This supposition of two indiscernibles, such as two pieces of matter perfectly alike, seems indeed to be possible in abstract terms, but it is not consistent with the order of things, nor with the divine wisdom by which nothing is admitted without reason. The vulgar fancy such things because they content themselves with incomplete notions. And this is one of the faults of the atomists.

22. Besides, I don't admit in matter parts perfectly solid, or that are the same throughout without any variety or particular motion in their parts, as the pretended atoms are imagined to be. To suppose such bodies is another popular opinion ill grounded. According to my demonstrations, every part of matter is actually subdivided into parts differently moved, and no one of them is perfectly like another.

23. I said that in sensible things two that are indiscernible can never be found; that, for instance, two leaves in a garden or two drops of water perfectly alike are not to be found. The author acknowledges it as to leaves and perhaps as to drops of water. But he might have admitted it without any hesitation, without a "perhaps" (an Italian would say *senza forse*), as to drops of water likewise.

24. I believe that these general observations in things sensible hold also in proportion in things insensible and that one may say in this respect what Harlequin says in the *Emperor of the Moon*: 'tis there just as 'tis here. And 'tis a great objection against indiscernibles that no instance of them is to be found.[425] But the author opposes this consequence, because (says he) sensible bodies are compounded, whereas he maintains there are insensible bodies which are simple. I answer again that I don't admit simple bodies. There is nothing simple, in my opinion, but true monads, which have neither parts nor extension. Simple bodies, and even perfectly similar ones, are a consequence of the false hypothesis

of a vacuum and of atoms, or of lazy philosophy, which does not sufficiently carry on the analysis of things and fancies it can attain to the first material elements of nature because our imagination would be therewith satisfied.

25. When I deny that there are two drops of water perfectly alike, or any two other bodies indiscernible from each other, I don't say 'tis absolutely impossible to suppose them but that 'tis a thing contrary to the divine wisdom, and which consequently does not exist.

To Sections 5 and 6.

26. I own that if two things perfectly indiscernible from each other did exist they would be two, but that supposition is false and contrary to the grand principle of reason. The vulgar philosophers were mistaken when they believed that there are two things different solo numero, or only because they are two, and from this error have arisen their perplexities about what they called the principle of individuation.[426] Metaphysics have generally been handled like a science of mere words, like a philosophical dictionary, without entering into the discussion of things. Superficial philosophy, such as is that of the atomists and vacuists, forges things which superior reasons do not permit. I hope my demonstrations will change the face of philosophy, notwithstanding such weak objections as the author raises here against me.

27. The parts of time and place considered in themselves are ideal things, and therefore they perfectly resemble one another like two abstract units. But it is not so with two concrete ones, or with two real times, or two spaces filled up, that is, truly actual.

28. I don't say that two points of space are one and the same point, nor that two instants of time are one and the same instant, as the author seems to charge me with saying. But a man may fancy, for want of knowledge, that there are two different instants where there is but one; in like manner, as I observed in the seventeenth paragraph of the foregoing answer, that frequently in geometry we suppose two in order to represent the error of a gain-

sayer, where there is really but one. If any man should suppose that a right line cuts another in two points, it will be found, after all, that these two pretended points must coincide and make but one point.

29. I have demonstrated that space is nothing else but an order of the existence of things observed as existing together, and therefore the fiction of a material finite universe moving forward in an infinite empty space cannot be admitted. It is altogether unreasonable and impracticable. For, besides that, there is no real space out of the material universe, such an action would be without any design in it; it would be working without doing anything, agendo nihil agere. There would happen no change which could be observed by any person whatsoever.[427] There are imaginations of philosophers who have incomplete notions, who make space an absolute reality. Mere mathematicians who are only taken up with the conceits of imagination are apt to forge such notions, but they are destroyed by superior reasons.

30. Absolutely speaking, it appears that God can make the material universe finite in extension, but the contrary appears more agreeable to his wisdom.

31. I don't grant that every finite is movable. According to the hypothesis of my adversaries themselves, a part of space, though finite, is not movable. What is movable must be capable of changing its situation with respect to something else and to be in a new state discernible from the first; otherwise the change is but a fiction. A movable finite must therefore make part of another finite, that any change may happen which can be observed.

32. Cartesius maintains that matter is unlimited,[428] and I don't think he has been sufficiently confuted. And though this be granted him, yet it does not follow that matter would be necessary, nor that it would have existed from eternity, since that unlimited diffusion of matter would only be an effect of God's choice judging that to be the better.

To Section 7.

33. Since space in itself is an ideal thing like time, space out

of the world must needs be imaginary, as the Schoolmen themselves have acknowledged. The case is the same with empty space within the world, which I take also to be imaginary, for the reasons before alleged.

34. The author objects against me the vacuum discovered by Mr. Guericke of Magdeburg, which is made by pumping the air out of a receiver, and he pretends that there is truly a perfect vacuum or a space without matter (at least in part) in that receiver.[429] The Aristotelians and Cartesians, who do not admit a true vacuum, have said in answer to that experiment of Mr. Guericke, as well as to that of Torricelli of Florence (who emptied the air out of a glass tube by the help of quicksilver), that there is no vacuum at all in the tube or in the receiver, since glass has small pores which the beams of light, the effluvia of the loadstone, and other very thin fluids may go through. I am of their opinion, and I think the receiver may be compared to a box full of holes in the water having fish or other gross bodies shut up in it, which, being taken out, their place would nevertheless be filled up with water. There is only this difference—that though water be fluid and more yielding than those gross bodies, yet it is as heavy and massive, if not more, than they, whereas the matter which gets into the receiver in the room of the air is much more subtle. The new sticklers for a vacuum allege in answer to this instance that it is not the grossness of matter but its mere quantity that makes resistan and consequently that there is of necessity more vacuum where there is less resistance. They add that the subtleness of matter has nothing to d here and that the particles of quicksilver are as subtle and fine as those of water, and yet that quicksilver resists above ten times more. To this I reply that it is not so much the quantity of matter as its difficulty of giving place that makes resistance. For instance, floating timber contains less of heavy matter than an equal bulk of water does, and yet it makes more resistance to a boat than the water does.

35. And as for quicksilver, 'tis true, it contains about fourteen times more of heavy matter than an equal bulk of water does, but it

does not follow that it contains fourteen times more matter absolutely. On the contrary, water contains as much matter, if we include both its own matter, which is heavy, and the extraneous matter void of heaviness which passes through its pores. For both quicksilver and water are masses of heavy matter, full of pores, through which there passes a great deal of matter void of heaviness (and which does not sensibly resist), such as is probably that of the rays of light and other insensible fluids, and especially that which is itself the cause of the gravity of gross bodies, by receding from the center toward which it drives those bodies. For it is a strange imagination to make all matter gravitate, and that toward all other matter, as if each body did equally attract every other body according to their masses and distances—and this by an attraction properly so called, which is not derived from an occult impulse of bodies, whereas the gravity of sensible bodies toward the center of the earth ought to be produced by the motion of some fluid. And the case must be the same with other gravities such as is that of the planets toward the sun or toward each other. (A body is never moved naturally except by another body which impels it by touching it, and afterward it advances until it is stopped by another body which touches it. Every other operation on bodies is either miraculous or imaginary.)[430]

To Sections 8 and 9.

36. I objected that space, taken for something real and absolute without bodies, would be a thing eternal, impassible, and independent upon God. The author endeavors to elude this difficulty by saying that space is a property of God. In answer to this I have said, in my foregoing paper, that the property of God is immensity but that space (which is often commensurate with bodies) and God's immensity are not the same thing.

37. I objected further that if space be a property, and infinite space be the immensity of God, finite space will be the extension or mensurability of something finite. And therefore the space taken up by a body will be the extension of that body. Which is an absurdity, since a body can change space but cannot leave its extension.[431]

38. I asked also, if space is a property, what thing will an empty limited space (such as that which my adversary imagines in an exhausted receiver) be the property of? It does not appear reasonable to say that this empty space, either round or square, is a property of God. Will it be then perhaps the property of some immaterial, extended, imaginary substances which the author seems to fancy in the imaginary spaces?

39. If space is the property or affection of the substance which is in space, the same space will be sometimes the affection of one body, sometimes of another body, sometimes of an immaterial substance, and sometimes perhaps of God himself, when it is void of all other substance, material or immaterial. But this is a strange property or affection, which passes from one subject to another. Thus subjects will leave off their accidents like clothes, that other subjects may put them on. At this rate how shall we distinguish accidents and substances?[432]

40. And if limited spaces are the affections of limited substances which are in them, and infinite space be a property of God, a property of God must (which is very strange) be made up of the affections of creatures, for all finite spaces taken together make up infinite space.

41. But if the author denies that limited space is an affection of limited things, it will not be reasonable neither that infinite space should be the affection or property of an infinite thing. I have suggested all these difficulties in my foregoing paper, but it does not appear that the author has endeavored to answer them.

42. I have still other reasons against this strange imagination that space is a property of God. If it be so, space belongs to the essence of God. But space has parts; therefore there would be parts in the essence of God. Spectatum admissi!

43. Moreover, spaces are sometimes empty and sometimes filled up. Therefore there will be in the essence of God parts sometimes empty and sometimes full and consequently liable to a perpetual change. Bodies filling up space would fill up part of God's

essence and would be commensurate with it; and in the supposition of a vacuum, part of God's essence will be within the receiver. Such a God having parts will very much resemble the Stoic's god, which was the whole universe considered as a divine animal.

44. If infinite space is God's immensity, infinite time will be God's eternity; and therefore we must say that what is in space is in God's immensity and consequently in his essence and that what is in time is also in the essence of God. Strange expressions, which plainly show that the author makes a wrong use of terms.

45. I shall give another instance of this. God's immensity makes him actually present in all spaces. But now if God is in space, how can it be said that space is in God or that it is a property of God? We have often heard that a property is in its subject, but we never heard that a subject is in its property. In like manner, God exists in all time. How then can time be in God, and how can it be a property of God? These are perpetual alloglossies.

46. It appears that the author confounds immensity, or the extension of things, with the space according to which that extension is taken. Infinite space is not the immensity of God; finite space is not the extension of bodies, as time is not their duration. Things keep their extension, but they do not always keep their space. Everything has its own extension, its own duration, but it has not its own time and does not keep its own space.

47. I will here show how men come to form to themselves the notion of space. They consider that many things exist at once, and they observe in them a certain order of coexistence, according to which the relation of one thing to another is more or less simple. This order is their situation or distance. When it happens that one of those coexistent things changes its relation to a multitude of others which do not change their relations among themselves, and that another thing, newly come, acquires the same relation to the others as the former had, we then say it is come into the place of the former; and this change we call a motion in that body wherein is the immediate cause of the change. And though many, or even

all, the coexistent things should change according to certain known rules of direction and swiftness, yet one may always determine the relation of situation which every coexistent acquires with respect to every other coexistent, and even that relation which any other coexistent would have to this, or which this would have to any other, if it had not changed or if it had changed any otherwise. And supposing or feigning that among those coexistents there is a sufficient number of them which have undergone no change, then we may say that those which have such a relation to those fixed existents as others had to them before have now the same *place* which those others had. And that which comprehends all those places is called *space*. Which shows that in order to have an idea of place, and consequently of space, it is sufficient to consider these relations and the rules of their changes, without needing to fancy any absolute reality out of the things whose situation we consider; and to give a kind of definition, *place* is that which we say is the same to *A* and to *B*, when the relation of the coexistence of *B*, with *C*, *E*, *F*, *G*, etc., agrees perfectly with the relation of the coexistence which *A* had with the same *C*, *E*, *F*, *G*, etc., supposing there has been no cause of change in *C*, *E*, *F*, *G*, etc. It might be said also, without entering into any further particularity, that place is that which is the same in different moments to different existent things when their relations of coexistence with certain other existents which are supposed to continue fixed from one of those moments to the other agree entirely together. And *fixed existents* are those in which there has been no cause of any change of the order of their coexistence with others, or (which is the same thing) in which there has been no motion. Lastly, *space* is that which results from places taken together. And here it may not be amiss to consider the difference between place and the relation of situation which is in the body that fills up the place. For the place of *A* and *B* is the same, whereas the relation of *A* to fixed bodies is not precisely and individually the same as the relation which *B* (that comes into its place) will have to the same fixed bodies; but these relations agree only. For two different subjects, as *A* and *B*, cannot have precisely the same individual affection, it being impossible that the same individual accident should be in two subjects or pass from one subject to another. But the mind, not contented with an agreement, looks for an identity, for something that should be truly the same, and conceives it as being extrinsic to the subject; and this is what we here call *place* and *space*. But this can only be an ideal thing, containing a certain order, wherein the mind conceives the application of relations.[433] In like manner as the mind can fancy to itself an order made up of genealogical lines whose bigness would consist only in the number of generations wherein every person would have his place; and if to this one should add the fiction of a metempsychosis and bring in the same human souls again, the persons in those lines might change place; he who was a father or a grandfather might become a son or a grandson, etc. And yet those genealogical places, lines, and spaces, though they should express real truths, would only be ideal things. I shall allege another example to show how the mind uses, upon occasion of accidents which are in subjects, to fancy to itself something answerable to those accidents out of the subjects. The ratio or proportion between two lines *L* and *M* may be conceived three several ways: as a ratio of the greater *L* to the lesser *M*, as a ratio of the lesser *M* to the greater *L*, and, lastly, as something abstracted from both, that is, the ratio between *L* and *M* without considering which is the antecedent or which the consequent, which the subject and which the object. And thus it is that proportions are considered in music. In the first way of considering them, *L* the greater, in the second, *M* the lesser, is the subject of that accident which philosophers call "relation." But which of them will be the subject in the third way of considering them? It cannot be said that both of them, *L* and *M* together, are the subject of such an accident; for, if so, we should have an accident in two subjects, with one leg in one and the other in the other, which is contrary to the notion of accidents. Therefore we must say that this relation, in this third way of considering it, is indeed out of the subjects;

but, being neither a substance nor an accident, it must be a mere ideal thing, the consideration of which is nevertheless useful. To conclude, I have here done much like Euclid, who, not being able to make his readers well understand what *ratio* is absolutely in the sense of geometricians, defines what are the *same ratios.* Thus, in like manner, in order to explain what *place* is, I have been content to define what is the *same place*. Lastly, I observe that the traces of movable bodies, which they leave sometimes upon the immovable ones on which they are moved, have given men occasion to form in their imagination such an idea, as if some trace did still remain, even when there is nothing unmoved. But this is a mere ideal thing and imports only that *if there was any unmoved thing there, the trace might be marked out upon it*. And 'tis this analogy which makes men fancy places, traces, and spaces, though these things consist only in the truth of relations and not at all in any absolute reality.

48. To conclude, if the space (which the author fancies) void of all bodies is not altogether empty, what is it then full of? Is it full of extended spirits perhaps, or immaterial substances capable of extending and contracting themselves which move therein and penetrate each other without any inconveniency, as the shadows of two bodies penetrate one another upon the surface of a wall? Methinks I see the revival of the odd imaginations of Dr. Henry More, otherwise a learned and well-meaning man, and of some others who fancied that those spirits can make themselves impenetrable whenever they please. Nay, some have fancied that man in the state of innocency had also the gift of penetration and that he became solid, opaque, and impenetrable by his fall. Is it not overthrowing our notions of things to make God have parts, to make spirits have extension? The principle of the want of a sufficient reason does alone drive away all these specters of imagination. Men easily run into fictions for want of making a right use of that great principle.

To Section 10.

49. It cannot be said that a certain duration is eternal but that

things, which continue always, are eternal, by gaining always new duration.[434] Whatever exists of time and of duration, being successive, perishes continually, and how can a thing exist eternally which (to speak exactly) does not exist at all? For how can a thing exist whereof no part does ever exist? Nothing of time does ever exist but instants, and an instant is not even itself a part of time. Whoever considers these observations will easily apprehend that time can only be an ideal thing. And the analogy between time and space will easily make it appear that the one is as merely ideal as the other. (However, if by saying that the duration of a thing is eternal is merely understood that it lasts eternally, I have no objection.)[430]

50. If the reality of space and time is necessary to the immensity and eternity of God, if God must be in space, if being in space is a property of God, he will in some measure depend upon time and space and stand in need of them. For I have already prevented that subterfuge—that space and time are in God and as it were properties of God. (Could the opinion which should affirm that bodies move about in the parts of the divine essence be maintained?)[430]

To Sections 11 and 12.

51. I objected that space cannot be in God because it has parts. Hereupon the author seeks another subterfuge by departing from the received sense of words, maintaining that space has no parts because its parts are not separable and cannot be removed from one another by discerption. But 'tis sufficient that space has parts, whether those parts be separable or not, and they may be assigned in space, either by the bodies that are in it or by lines and surfaces that may be drawn and described in it.

To Section 13.

52. In order to prove that space without bodies is an absolute reality, the author objected that a finite material universe might move forward in space. I answered, it does not appear reasonable that the material universe should be finite, and though we should

suppose it to be finite, yet 'tis unreasonable it should have motion any otherwise than as its parts change their situation among themselves, for then there is motion in space, but it consists in the order of relations which are changed. The author replies now that the reality of motion does not depend upon being observed and that a ship may go forward, and yet a man who is in the ship may not perceive it. I answer, motion does not indeed depend upon being observed, but it does depend upon being possible to be observed. There is no motion when there is no change that can be observed. And when there is no change that can be observed, there is no change at all.[435] The contrary opinion is grounded upon the supposition of a real absolute space, which I have demonstratively confuted by the principle of the want of a sufficient reason.

53. I find nothing in the eighth definition of the Mathematical Principles of Nature, nor in the scholium belonging to it, that proves or can prove the reality of space in itself.[436] However, I grant there is a difference between an absolute true motion of a body and a mere relative change of its situation with respect to another body. For when the immediate cause of the change is in the body, that body is truly in motion, and then the situation of other bodies with respect to it will be changed consequently, though the cause of that change be not in them. 'Tis true that, exactly speaking, there is not any one body that is perfectly and entirely at rest, but we will frame an abstract notion of rest by considering the thing mathematically. Thus have I left nothing unanswered of what has been alleged for the absolute reality of space. And I have demonstrated the falsehood of that reality by a fundamental principle, one of the most certain both in reason and experience, against which no exception or instance can be alleged. Upon the whole, one may judge from what has been said that I ought not to admit a movable universe, nor any place out of the material universe.

To Section 14.

54. I am not sensible of any objection but what I think I have

sufficiently answered. As for the objection that space and time are quantities, or rather things endowed with quantity, and that situation and order are not so, I answer that order also has its quantity; there is in it that which goes before and that which follows; there is distance or interval. Relative things have their quantity as well as absolute ones. For instance, ratios or proportions in mathematics have their quantity and are measured by logarithms, and yet they are relations.[437] And therefore, though time and space consist in relations, yet they have their quantity.

To Section 15.

55. As to the question whether God could have created the world sooner, 'tis necessary here to understand each other rightly. Since I have demonstrated that time, without things, is nothing else but a mere ideal possibility, 'tis manifest if anyone should say that this same world which has been actually created might have been created sooner without any other change, he would say nothing that is intelligible. For there is no mark or difference whereby it would be possible to know that this world was created sooner. And, therefore (as I have already said), to suppose that God created the same world sooner is supposing a chimerical thing. 'Tis making time a thing absolute, independent upon God, whereas time must coexist with creatures and is only conceived by the order and quantity of their changes.

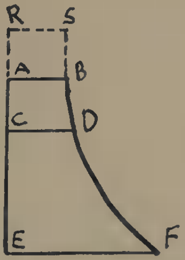


Fig. 39

56. But yet, absolutely speaking, one may conceive that a universe began sooner than it actually did. Let us suppose our universe or any other to be represented by the figure AF and that the ordinate AB represents its first state and the ordinates CD and EF its following states; I say one may conceive that such a world began sooner by conceiving the figure prolonged backward and by adding to it SRABS (Fig. 39). For thus,

things being increased, time will be also increased. But whether such an augmentation be reasonable and agreeable to God's wisdom is another question, to which we answer in the negative; otherwise God would have made such an augmentation.[438] It would be like as

> Humano capiti cervicem pictor equinam
> Jungere si velit.[439]

The case is the same with respect to the destruction[440] of the universe. As one might conceive something added to the beginning, so one might also conceive something taken off toward the end. But such a retrenching from it would be also unreasonable.

57. Thus it appears how we are to understand that God created things at what time he pleased, for this depends upon the things which he resolved to create. But things being once resolved upon, together with their relations, there remains no longer any choice about the time and the place, which of themselves have nothing in them real, nothing that can distinguish them, nothing that is at all discernible.

58. One cannot therefore say, as the author does here, that the wisdom of God may have good reasons to create this world at such or such a particular time, that particular time considered without the things being an impossible fiction, and good reasons for a choice being not to be found where everything is indiscernible.

59. When I speak of this world, I mean the whole universe of material and immaterial creatures taken together, from the beginning of things. But if anyone mean only the beginning of the material world, and suppose immaterial creatures before it, he would have somewhat more reason for his supposition. For time then being marked by things that existed already, it would be no longer indifferent, and there might be room for choice. And yet, indeed, this would be only putting off the difficulty. For supposing the whole universe of immaterial and material creatures together to

have a beginning, there is no longer any choice about the time in which God would place that beginning.

60. And therefore one must not say, as the author does here, that God created things in what particular space and at what particular time he pleased. For all time and all spaces being in themselves perfectly uniform and indiscernible from each other, one of them cannot please more than another.

61. I shall not enlarge here upon my opinion explained elsewhere that there are no created substances wholly destitute of matter. For I hold with the ancients, and according to reason, that angels or intelligences, and souls separated from a gross body, have always subtle bodies, though they themselves be incorporeal. The vulgar philosophy easily admits all sorts of fictions; mine is more strict.

62. I don't say that matter and space are the same thing. I only say there is no space where there is no matter and that space in itself is not an absolute reality. Space and matter differ as time and motion. However, these things, though different, are inseparable.

63. But it does not at all follow that matter is eternal and necessary, unless we suppose space to be eternal and necessary—a supposition ill grounded in all respects.

To Sections 16 and 17.

64. I think I have answered everything, and I have particularly replied to that objection that space and time have quantity and that order has none. See above, No. 54.

65. I have clearly shown that the contradiction lies in the hypothesis of the opposite opinion, which looks for a difference where there is none. And it would be a manifest iniquity to infer from thence that I have acknowledged a contradiction in my own opinion.

To Section 18.

66. There I find again an argument which I have overthrown above, No. 17. The author says God may have good reasons to make two cubes perfectly equal and alike, and then (says he) God

must needs assign them to their places, though every other respect be perfectly equal. But things ought not to be separated from their circumstances. This argument consists in incomplete notions. God's resolutions are never abstract and imperfect, as if God decreed first to create the two cubes and then made another decree where to place them. Men, being such limited creatures as they are, may act in this manner. They may resolve upon a thing and then find themselves perplexed about means, ways, places, and circumstances. But God never takes a resolution about the ends without resolving at the same time about the means and all the circumstances. Nay, I have shown in my Theodicy that, properly speaking, there is but one decree for the whole universe, whereby God resolved to bring it out of possibility into existence. And therefore God will not choose a cube without choosing its place at the same time, and he will never choose among indiscernibles.

67. The parts of space are not determined and distinguished but by the things which are in it, and the diversity of things in space determines God to act differently upon different parts of space. But space without things has nothing whereby it may be distinguished and, indeed, not anything actual.

68. If God is resolved to place a certain cube of matter at all, he is also resolved in which particular place to put it. But 'tis with respect to other parts of matter, and not with respect to bare space itself, in which there is nothing to distinguish it.

69. But wisdom does not allow God to place at the same time two cubes perfectly equal and alike, because there is no way to find any reason for assigning them different places. At this rate there would be a will without a motive.

70. A will without a motive, such as superficial reasoners suppose to be in God, I compared to Epicurus' chance. The author answers, Epicurus' chance is a blind necessity and not a choice of will. I reply that Epicurus' chance is not a necessity but something indifferent. Epicurus brought it in on purpose to avoid necessity.

'Tis true, chance is blind, but a will without motive would be no less blind and no less owing to mere chance.

To Section 19.

71. The author repeats here what has been already confuted above, No. 21—that matter cannot be created without God's choosing among indiscernibles. He would be in the right if matter consisted of atoms, similar particles, or other the like fictions of superficial philosophy. But that great principle which proves there is no choice among indiscernibles destroys also these ill-contrived fictions.

To Section 20.

72. The author objected against me in his third paper (Nos. 7 and 8) that God would not have in himself a principle of acting if he was determined by things external. I answered that the ideas of external things are in him and that therefore he is determined by internal reasons, that is, by his wisdom. But the author here will not understand to what end I said it.

To Section 21.

73. He frequently confounds in his objections against me what God will not do with what he cannot do. See above, No. 9, and below, No. 76. For example, God can do everything that is possible, but he will do only what is best. And therefore I don't say, as the author here will have it, that God cannot limit the extension of matter; but 'tis likely he will not do it and that he has thought it better to set no bounds to matter.

74. From extension to duration, *non valet consequentia*. Though the extension of matter were unlimited, yet it would not follow that its duration would be also unlimited; nay, even *a parte ante*, it would not follow that it had no beginning. If it is the nature of things in the whole to grow uniformly in perfection, the universe of creatures must have had a beginning.[441] And therefore there will be reasons to limit the duration of things, even though there were none to limit their extension. Besides, the world's having a beginning does not derogate from the infinity of its duration *a parte post*, but bounds of

the universe would derogate from the infinity of its extension. And therefore it is more reasonable to admit a beginning of the world than to admit any bounds of it, that the character of its infinite author may be in both respects preserved.

75. However, those who have admitted the eternity of the world, or, at least (as some famous divines have done), the possibility of its eternity, did not for all that deny its dependence upon God, as the author here lays to their charge without any ground.

To Sections 22 and 23.

76. He here further objects, without any reason, that, according to my opinion, whatever God can do he must needs have done. As if he was ignorant that I have solidly confuted this notion in my Theodicy, and that I have overthrown the opinion of those who maintain that there is nothing possible but what really happens, as some ancient philosophers did, and, among others, Diodorus in Cicero.[442] The author confounds moral necessity, which proceeds from the choice of what is best, with absolute necessity; he confounds the will of God with his power. God can produce everything that is possible or whatever does not imply a contradiction, but he wills only to produce what is the best among things possible. See what has been said above, Nos. 9 and 74.

77. God is not therefore a necessary agent in producing creatures, since he acts with choice. However, what the author adds here is ill grounded, viz., that a necessary agent would not be an agent at all. He frequently affirms things boldly and without any ground, advancing against me notions which cannot be proved.

To Sections 24-28.

78. The author alleges it was not affirmed that space is God's sensorium but only, as it were, his sensorium. The latter seems to be as improper and as little intelligible as the former.

To Section 29.

79. Space is not the place of all things, for it is not the place of God. Otherwise there would be a thing coeternal with God and

independent upon him; nay, he himself would depend upon it if he has need of place.

80. Nor do I see how it can be said that space is the place of ideas, for ideas are in the understanding.

81. 'Tis also very strange to say that the soul of man is the soul of the images it perceives. The images, which are in the understanding, are in the mind, but if the mind was the soul of the images, they would then be extrinsic to it. And if the author means corporeal images, how then will he have a human mind to be the soul of those images, they being only transient impressions in a body belonging to that soul?

82. If 'tis by means of a sensorium that God perceives what passes in the world, it seems that things act upon him and that therefore he is what we mean by a soul of the world. The author charges me with repeating objections without taking notice of the answers, but I don't see that he has answered this difficulty. They had better wholly lay aside this pretended sensorium.

To Section 30.

83. The author speaks as if he did not understand how, according to my opinion, the soul is a representative principle. Which is as if he had never heard of my pre-established harmony.

84. I don't assent to the vulgar notions that the images of things are conveyed by the organs of sense to the soul. For it is not conceivable by what passage, or by what means of conveyance, these images can be carried from the organ to the soul. This vulgar notion in philosophy is not intelligible, as the new Cartesians have sufficiently shown. It cannot be explained how immaterial substance is affected by matter, and to maintain an unintelligible notion thereupon is having recourse to the Scholastic chimerical notion of I know not what inexplicable species intentionales passing from the organs to the soul. Those Cartesians saw the difficulty, but they could not explain it.[443] They had recourse to a certain wholly special concourse of God, which would really be miraculous. But I think I have given the true solution of that enigma.

85. To say that God perceives what passes in the world because he is present to the things, and not by the dependence which the continuation of their existence has upon him and which may be said to involve a continual production of them, is saying something unintelligible. A mere presence or proximity of coexistence is not sufficient to make us understand how that which passes in one being should answer to what passes in another.

86. Besides, this is exactly falling into that opinion which makes God to be the soul of the world, seeing it supposes God to perceive things, not by their dependence upon him, that is, by a continual production of what is good and perfect in them, but by a kind of perception, such as that by which men fancy our soul perceives what passes in the body. This is a degrading of God's knowledge very much.

87. In truth and reality, this way of perception is wholly chimerical and has no place even in human souls. They perceive what passes without them by what passes within them, answering to the things without, in virtue of the harmony which God has pre-established by the most beautiful and the most admirable of all his productions, whereby every simple substance is by its nature (if one may so say) a concentration and a living mirror of the whole universe according to its point of view. Which is likewise one of the most beautiful and most undeniable proofs of the existence of God, since none but God, viz., the universal cause, can produce such a harmony of things. But God himself cannot perceive things by the same means whereby he makes other beings perceive them. He perceives them because he is able to produce that means. And other beings would not be caused to perceive them if he himself did not produce them all harmonious and had not therefore in himself a representation of them; not as if that representation came from the things, but because the things proceed from him and because he is the efficient and exemplary cause of them. He perceives them because they proceed from him—if one may be allowed to say that he perceives them, which ought not to be said unless we divest

that word of its imperfection, for else it seems to signify that things act upon him. They exist and are known to him because he understands and wills them and because what he wills is the same as what exists. Which appears so much the more because he makes them to be perceived by one another and makes them perceive one another in consequence of the natures which he has given them once for all and which he keeps up only according to the laws of every one of them severally, which, though different one from another, yet terminate in an exact correspondence of the results of the whole. This surpasses all the ideas which men have generally framed concerning the divine perfections and the works of God and raises (our notion of)[444] them to the highest degree, as Mr. Bayle has acknowledged, though he believed, without any ground, that it exceeded possibility.[445]

88. To infer from that passage of Holy Scripture, wherein God is said to have rested from his works, that there is no longer a continual production of them would be to make a very ill use of that text. 'Tis true, there is no production of new simple substances, but it would be wrong to infer from thence that God is now in the world only as the soul is conceived to be in the body, governing it merely by his presence without any concourse being necessary to continue its existence.

To Section 31.

89. The harmony or correspondence between the soul and the body is not a perpetual miracle but the effect or consequence of an original miracle worked at the creation of things, as all natural things are. Though indeed it is a perpetual wonder, as many natural things are.

90. The word "pre-established harmony" is a term of art, I confess, but 'tis not a term that explains nothing, since it is made out very intelligibly; and the author alleges nothing that shows there is any difficulty in it.

91. The nature of every simple substance, soul, or true monad being such that its following state is a consequence of the pre-

ceding one, here now is the cause of the harmony found out. For God needs only to make a simple substance become once and from the beginning a representation of the universe according to its point of view, since from thence alone it follows that it will be so perpetually and that all simple substances will always have a harmony among themselves because they always represent the same universe.

To Section 32.

92. 'Tis true that according to me the soul does not disturb the laws of the body, nor the body those of the soul, and that the soul and body do only agree together, the one acting freely according to the rules of final causes and the other acting mechanically according to the laws of efficient causes. But this does not derogate from the liberty of our souls, as the author here will have it. For every agent which acts[446] according to final causes is free, though it happens to agree with an agent acting only by efficient causes without knowledge, or mechanically, because God, foreseeing what the free cause would do, did from the beginning regulate the machine in such a manner that it cannot fail to agree with that free caus Mr. Jaquelot has very well resolved this difficulty in one of his books against Mr. Bayle, and I have cited the passage in my Theodicy, Part I, Section 63. I shall speak of it again below, No. 124.

To Section 33.

93. I don't admit that every action gives a new force to the patient. It frequently happens in the concourse of bodies that each of them preserves its force, as when two equal hard bodies meet directly. Then the direction only is changed without any change in the force, each of the bodies receiving the direction of the other and going back with the same swiftness it came.

94. However, I am far from saying that it is supernatural to give a new force to a body, for I acknowledge that one body does frequently receive a new force from another, which loses as much of its own. But I say only 'tis supernatural that the whole universe of bodies should receive a new force, and consequently that one body should acquire any new force without the loss of as much in

others. And therefore I say likewise, 'tis an indefensible opinion to suppose the soul gives force to the body, for then the whole universe of bodies would receive a new force.

95. The author's dilemma here is ill grounded, viz., that, according to me, either a man must act supernaturally or be a mere machine like a watch. For man does not act supernaturally, and his body is truly a machine acting only mechanically, and yet his soul is a free cause.

To Sections 34 and 35.

96. I here refer to what has been or shall be said in this paper, Nos. 82, 86, 88, and 111, concerning the comparison between God and a soul of the world, and how the opinion contrary to mine brings the one of these too near to the other.

To Section 36.

97. I here also refer to what I have before said concerning the harmony between the soul and the body; No. 89, etc.

To Section 37.

98. The author tells us that the soul is not in the brain but in the sensorium, without saying what that sensorium is. But supposing that sensorium to be extended, as I believe the author understands it, the same difficulty still remains, and the question returns whether the soul be diffused through that whole extension, be it great or small. For more or less in bigness is nothing to the purpose here.

To Section 38.

99. I don't undertake here to establish my Dynamics or my doctrine of forces; this would not be a proper place for it. However, I can very well answer the objection here brought against me. I have affirmed that active forces are preserved in the world (without diminution).[447] The author objects that two soft or unelastic bodies meeting together lose some of their force. I answer, "No." 'Tis true their wholes lose it with respect to their total motion, but their parts receive it, being shaken internally by the force of the concourse. And therefore that loss of force is only in

appearance. The forces are not destroyed but scattered among the small parts. The bodies do not lose their forces, but the case here is the same as when men change great money into small.[448] However, I agree that the quantity of motion does not remain the same, and herein I approve what Sir Isaac Newton says, page 341 of his Optics, which the author here quotes. But I have shown elsewhere that there is a difference between the quantity of motion and the quantity of force.

To Section 39.

100. The author maintained against me that force does naturally lessen in the material universe and that this arises from the dependence of things (third reply, Secs. 13 and 14). In my third answer, I desired him to prove that this imperfection is a consequence of the dependence of things. He avoids answering my demand by falling upon an incident and denying this to be an imperfection. But whether it be an imperfection or not, he should have proved that 'tis a consequence of the dependence of things.

101. However, that which would make the machine of the world as imperfect as that of an unskilful watchmaker surely must needs be an imperfection.

102. The author says now that it is a consequence of the inertia of matter. But this also he will not prove. That inertia alleged here by him, mentioned by Kepler, repeated by Cartesius in his letters, and made use of by me in my Theodicy in order to give a notion, and at the same time an example, of the natural imperfection of creatures has no other effect than to make the velocities diminish when the quantities of matter are increased, but this is without any diminution of the forces.[449]

To Section 40.

103. I maintained that the dependence of the machine of the world upon its divine author is rather a reason why there can be no such imperfection in it, and that the work of God does not want to be set right again, that it is not liable to be disordered, and, lastly, that it cannot lessen in perfection. Let anyone guess now

how the author can hence infer against me, as he does, that if this be the case, then the material world must be infinite and eternal, without any beginning, and that God must always have created as many men and other kinds of creatures as can possibly be created.

To Section 41.

104. I don't say that space is an order or situation which makes things capable of being situated; this would be nonsense. Anyone needs only consider my own words, and add them to what I said above, No. 47, in order to show how the mind comes to form to itself an idea of space, and yet that there needs not be any real and absolute being answering to that idea distinct from the mind and from all relations. I don't say, therefore, that space is an order or situation, but an order of situations, or an order according to which situations are disposed, and that abstract space is that order of situations when they are conceived as being possible. Space is therefore something merely ideal. But it seems the author will not understand me. I have already, in this paper, No. 54, answered the objection that order is not capable of quantity.

105. The author objects here that time cannot be an order of successive things because the quantity of time may become greater or less, and yet the order of successions continue the same. I answer, this is not so. For, if the time is greater, there will be more successive and like states interposed, and, if it be less, there will be fewer, seeing there is no vacuum, nor condensation, nor penetration (if I may so speak) in times any more than in places.

106. 'Tis true, I maintain that the immensity and eternity of God would subsist though there were no creatures, but those attributes would have no dependence either on times or places. If there were no creatures, there would be neither time nor place, and consequently no actual space. The immensity of God is independent upon space, as his eternity is independent upon time. These attributes signify only, in respect to these two orders of things, that God would be present and coexistent with all the things that should exist. And therefore I don't admit what's here alleged, that if God

existed alone there would be time and space as there is now, whereas then, in my opinion, they would be only in the ideas of God as mere possibilities. The immensity and eternity of God are things more transcendent than the duration and extension of creatures, not only with respect to the greatness, but also to the nature of the things. Those divine attributes do not imply the supposition of things extrinsic to God, such as are actual places and times. These truths have been sufficiently acknowledged by divines and philosophers.

To Section 42.

107. I maintained that an operation of God by which he should mend the machine of the material world, tending in its nature, as this author pretends, to lose all its motion, would be a miracle. His answer was that it would not be a miraculous operation because it would be usual and must frequently happen. I replied that 'tis not usualness or unusualness that makes a miracle properly so called, or a miracle of the highest sort, but its surpassing the powers of creatures, and that this is the general opinion of divines and philosophers; and that therefore the author acknowledges at least that the thing he introduces and I disallow is, according to the received notion, a miracle of the highest sort, that is, one which surpasses all created powers, and that this is the very thing which all men endeavor to avoid in philosophy. He answers now that this is appealing from reason to vulgar opinion. But I reply again that this vulgar opinion, according to which we ought in philosophy to avoid as much as possible what surpasses the natures of creatures, is a very reasonable opinion. Otherwise nothing will be easier than to account for anything by bringing in the deity, deum ex machina, without minding the natures of things.

108. Besides, the common opinion of divines ought not to be looked upon merely as vulgar opinion. A man should have weighty reasons before he ventures to contradict it, and I see no such reasons here.

109. The author seems to depart from his own notion, accord-

ing to which miracle ought to be unusual, when in Section 31, he objects to me—though without any ground—that the pre-established harmony would be a perpetual miracle. Here, I say, he seems to depart from his own notion, unless he had a mind to argue against me *ad hominem.*

To Section 43.

110. If a miracle differs from what is natural only in appearance and with respect to us, so that we call that only a miracle which we seldom see, there will be no internal real difference between a miracle and what is natural, and at the bottom everything will be either equally natural or equally miraculous. Will divines like the former, or philosophers the latter?

111. Will not this doctrine, moreover, tend to make God the soul of the world, if all his operations are natural like those of our souls upon our bodies? And so God will be a part of nature.

112. In good philosophy and sound theology we ought to distinguish between what is explicable by the natures and powers of creatures and what is explicable only by the powers of the infinite substance. We ought to make an infinite difference between the operation of God, which goes beyond the extent of natural powers, and the operations of things that follow the law which God has given them, and which he has enabled them to follow by their natural powers, though not without his assistance.

113. This overthrows attractions, properly so called, and other operations inexplicable by the natural powers of creatures, which kinds of operations the assertors of them must suppose to be effected by miracle, or else have recourse to absurdities, that is, to the occult qualities of the Schools, which some men begin to revive under the specious name of forces, but they bring us back again into the kingdom of darkness. This is *inventa fruge, glandibus vesci.*[450]

114. In the time of Mr. Boyle and other excellent men who flourished in England under Charles the Second, nobody would have ventured to publish such chimerical notions. *I hope that*

happy time will return under so good a government as the present and that minds a little too much carried away by the misfortune of the times will betake themselves to the better cultivation of sound learning. Mr. Boyle made it his chief business to inculcate that everything was done mechanically in natural philosophy.[451] But it is men's misfortune to grow at last out of conceit with reason itself and to be weary of light. Chimeras begin to appear again, and they are pleasing because they have something in them that is wonderful. What has happened in poetry happens also in the philosophical world. People are grown weary of rational romances such as were the French Clélie or the German Aramene, and they are become fond again of the tales of fairies.[452]

115. As for the motions of the celestial bodies and even the formation of plants and animals, there is nothing in them that looks like a miracle except their beginning. The organism of animals is a mechanism which supposes a divine preformation. What follows upon it is purely natural and entirely mechanical.[453]

116. Whatever is performed in the body of man and of every animal is no less mechanical than what is performed in a watch. The difference is only such as ought to be between a machine of divine invention and the workmanship of such a limited artist as man is.

To Section 44.

117. There is no difficulty among divines about the miracles of angels. The question is only about the use of that word. It may be said that angels work miracles, but less properly so called, or of an inferior order. To dispute about this would be a mere question about a word. It may be said that the angel who carried Habakkuk through the air, and he who troubled the water of the pool of Bethesda, worked a miracle. But it was not a miracle of the highest order, for it may be explained by the natural powers of angels, which surpass those of man.

To Section 45.

118. I objected that an attraction, properly so called or in

the Scholastic sense, would be an operation at a distance without any means intervening. The author answers here that an attraction without any means intervening would be indeed a contradiction. Very well. But then what does he mean when he will have the sun to attract the globe of the earth through an empty space? Is it God himself that performs it? But this would be a miracle if ever there was any. This would surely exceed the powers of creatures.

119. Or are perhaps some immaterial substances or some spiritual rays, or some accident without a substance, or some kind of species intentionalis, or some other "I know not what," the means by which this is pretended to be performed? Of which sort of things the author seems to have still a good stock in his head, without explaining himself sufficiently.

120. That means of communication, says he, is invisible, intangible, not mechanical. He might as well have added inexplicable, unintelligible, precarious, groundless, and unexampled.

121. But it is regular, says the author; it is constant and consequently natural. I answer, it cannot be regular without being reasonable, nor natural unless it can be explained by the natures of creatures.

122. If the means which causes an attraction properly so called be constant and at the same time inexplicable by the powers of creatures, and yet be true, it must be a perpetual miracle, and if it is not miraculous it is false. 'Tis a chimerical thing, a Scholastic occult quality.

123. The case would be the same as in a body going round without receding in the tangent, though nothing that can be explained hindered it from receding. Which is an instance I have already alleged, and the author has not thought fit to answer it because it shows too clearly the difference between what is truly natural, on the one side, and a chimerical occult quality of the Schools, on the other.

To Section 46.

124. All the natural forces of bodies are subject to mechan-

ical laws, and all the natural powers of spirits are subject to moral laws. The former follow the order of efficient causes, and the latter follow the order of final causes. The former operate without liberty, like a watch; the latter operate with liberty, though they exactly agree with that machine which another cause, free and superior, has adapted to them beforehand. I have already spoken of this above, No. 92.

125. I shall conclude with what the author objected against me at the beginning of this fourth reply, to which I have already given an answer above, Nos. 18, 19, 20. But I have deferred speaking more fully upon that head to the conclusion of this paper. He pretended that I have been guilty of a petitio principii. But of what principle, I beseech you? Would to God less clear principles had never been laid down. The principle in question is the principle of the want of a sufficient reason in order to anything's existing, in order to any event's happening, in order to any truth's taking place. Is this a principle that wants to be proved? The author granted it or pretended to grant it, No. 2 of his third paper, possibly because the denial of it would have appeared too unreasonable. But either he has done it only in words or he contradicts himself or retracts his concession.

126. I dare say that without this great principle one cannot prove the existence of God, nor account for many other important truths.

127. Has not everybody made use of this principle upon a thousand occasions? 'Tis true, it has been neglected out of carelessness on many occasions, but that neglect has been the true cause of chimeras such as are, for instance, an absolute real time or space, a vacuum, atoms, attraction in the Scholastic sense, a physical influence of the soul over the body, and a thousand other fictions either derived from erroneous opinions of the ancients or lately invented by modern philosophers.

128. Was it not upon account of Epicurus' violating this great principle that the ancients derided his groundless declination of

atoms? And I dare say the Scholastic attraction, revived in our days and no less derided about thirty years ago, is not at all more reasonable.

129. I have often defied people to allege an instance against that great principle, to bring any one uncontested example wherein it fails. But they have never done it, nor ever will. 'Tis certain there is an infinite number of instances wherein it succeeds, or rather it succeeds in all the known cases in which it has been made use of. From whence one may reasonably judge that it will succeed also in unknown cases, or in such cases as can only by its means become known, according to the method of experimental philosophy which proceeds a posteriori, though the principle were not perhaps otherwise justified by bare reason, or a priori.[454]

130. To deny this great principle is likewise to do as Epicurus did, who was reduced to deny that other great principle, viz., the principle of contradiction, which is that every intelligible enunciation must be either true or false. Chrysippus undertook to prove that principle against Epicurus, but I think I need not imitate him. I have already said what is sufficient to justify mine, and I might say something more upon it, but perhaps it would be too abstruse for this present dispute. And I believe reasonable and impartial men will grant me that having forced an adversary to deny that principle is reducing him _ad absurdum._[455]

NOTES

NOTES TO VOLUME II

No. 38. Letter to Arnauld

1. After the last philosophical letter of 1687 (No. 36, II), Leibniz had sent a more personal one from Nürnberg in 1688 (G., II, 132-34). He had also drafted one on religious questions which was not sent (G., II, 129-30).

2. Michel le Tellier (1643-1719) was a Jesuit and confessor of Louis XIV. His *Défense des nouveau chrétiens et des missionaires de la Chine, du Japon, et des Indes* (1687) had been attacked by Arnauld and referred to Rome for a judgment. In view of the close relations between Leibniz and the Jesuits in Rome at this time, his remark is discreetly ambiguous and diplomatic.

3. Two advances from the earlier correspondence are here noteworthy; Leibniz has partly cleared up the ambiguity about the nature of corporeal beings, and he has interpreted the "individual concept" as a law governing a continuous series.

4. Leibniz's discussion here is restricted to physical force, or, as he later calls it, derivative force. His analysis of the three aspects of force and the formulas for their conservation is developed in the account of *living force* in the *Specimen dynamicum,* Part I (No. 46). See n. 97 below.

5. A deferent circle, in the Ptolemaic system, was the path of a body, or of the center of an epicycle, about the earth. At this point the text follows the letter as sent to Arnauld. Montgomery gives the version of the first draft, which involved more details on the cosmological position (cf. G., II, 137, 138 n.).

6. Thus Leibniz seeks an a priori verification of Newton's law of inverse squares and an interpretation reconciling it with the vortices of Descartes and Huygens. For more details see No. 43. Leibniz had received a copy of Newton's *Principia mathematica philosophiae naturalis* (1687) while on his journey and had sent a review of it to the *Acta eruditorum* which appeared in June, 1688. The effort to secure credit for some of his own conclusions which he now found in Newton must have moved him to work so intensively in this period at physical studies which he had begun long before at Mainz. Leibniz's reasoning, though it strives for a broader application of the law of inverse squares than to gravity alone, is less general than Newton's (*Principia,* Book I, Propositions 1, 2, 14), since it presupposes harmonic motion.

7. See Vol. I, No. 27.

No. 39. ON THE METHOD OF DISTINGUISHING REAL FROM IMAGINARY PHENOMENA

8. Correspondence with fact, conformity with past experience, agreement with the experiences of others, and fruitfulness in prediction through hypotheses are thus the criteria for empirical truth for Leibniz. One

of the marks of a genuine idea was for him its operation, and mere combinations of symbols or qualities which lack this practical applicability do not express an idea.

9. BC., II, 127, here inserts a *non* which is not in G. and which alters the sense unjustifiably.

10. G., VII, 321, omits the negative, reading: "there are many extrinsic denominations." We read *nullae* for *multae.*

11. Note that here *metaphysical matter,* or *materia prima,* is an aspect of the monad or individual substance rather than of the composite bodies, as in the physical treatises which follow. The relation between primary matter in the monad (its static, qualitative aspect) and primary matter in bodies (extension and inertia) is one of the controversial issues which played a part in the correspondence with Des Bosses (No. 62). See n. 93.

No. 40. ON THE TRUE *THEOLOGIA MYSTICA*

12. The analogy of Leibniz's mystico-theological terminology with his logical and metaphysical terms may be suggested in the following equivalents.

perfections	simple primary concepts which make possible all definition and determination
degree of perfection	"quantity of essence" or of logical determination
imperfections (plural)	finiteness and plurality, confused and inadequate representation of many in one
attributes of God	primary concepts and truths
essential light	the region of ideas or possibilities
radiation	operation of ideas through the law of the best possible
finding God's perfections	using the method of analysis and synthesis
inner light	discovery of the law of one's individuality through the internal sense or reflection
shadows	external senses, confused and indistinct knowledge
nonbeing	passivity, *materia prima*
self-being	activity according to the law of the individual

Thus self-denial involves clear and distinct representation of universal harmony, whether in science or in ethical and social relations.

13. Leibniz, while in Rome, developed the plan of transforming the monasteries into research institutions or, perhaps, of forming a religious order for developing the universal encyclopedia (Guh. L., II, 92-93; Cout. OF., pp. 3, 5-6).

14. Leibniz's notes on William Penn's journal contain the following comment: "The true sign of the spirit and the grace of God is to enlighten and make better; everything else is freakishness and fancy" (Baruzi, *Leibniz,* p. 335; Bod. HS., I, v, 3).

15. Leibniz was aware of the psychological causes of some so-called "mystical phenomena." His letter to the Electress Sophia in 1691, about the dreams and visions of Fräulein Rosamunde von Asseburg, which were then being widely discussed, is an example. "I marvel at the *nature of the human spirit,* all of whose powers and capacities we do not know. When we meet such persons, we must, far from condemning and trying to change them, try rather to conserve them in this beautiful frame of mind, just as one preserves a curiosity or a cabinet-piece." After repeating the criteria by which true perceptions are to be distinguished (No. 39), and pointing out that visions are related to the natural constitutions of those who have them, he adds the following: "I sometimes think that Ezekiel must have studied architecture or been a court engineer, for he had magnificent visions of beautiful buildings. But a prophet from the country, like Hosea or Amos, sees only landscapes and rural pictures, while Daniel, who was a statesman, rules the kingdoms of the world" (Guh. L., II, 40-41).

16. An allusion to the binary number system, "the image of creation," in which all numbers are derived from unity and zero.

17. "Two irregularities can sometimes make something regular."

No. 41. *A Study in the Logical Calculus*

18. At this point the companion study, the "Not Inelegant Example," included the following proposition on subtraction: "*If coincident terms are subtracted from coincident terms, the remainders will coincide.* If $A \infty L$, and $B \infty M$, then $A - B \infty L - M$. For $A - B \infty A - B$ (this is true in itself), and, by substituting L for A and M for B on either side (by the definition of coincidents), the result is that $A - B \infty L - M$. Q.E.D."

    This theorem was accompanied by the following marginal note: "Subtraction of concepts is one thing, negation another. For example, nonrational man is absurd or impossible. But it is permissible to say that an ape is a man except that it is not rational. [They are] men except in the respect in which man differs from a beast, as in the Jumbo of Grotius. Man - rational is different from nonrational man. For man - rational ∞ beast. But nonrational man is impossible. Man - rational - animal is nothing. Hence subtraction can result in nothing or in simple nonexistence; in fact, in less than nothing. But negation gives impossibility" (G., VII, 232-33 and note).

19. Reading SY for ST (G., VII, 242) and, below, SX for SY and RX for RY.

20. *G.* has L.

21. The parallel to the distinction between nominal and real definitions, so frequently discussed by Leibniz, at once suggests itself.

22. That is, the rules will be the same, whether the proposition is interpreted intensionally or extensionally.

23. One of Leibniz's many names for his new science, derived from the more particular "specious analysis" of Descartes, or algebra (cf. Vol. I, No. 13 and n. 146).

No. 42. CRITICAL THOUGHTS ON THE GENERAL PART OF THE PRINCIPLES OF DESCARTES

24. Euclid's definition of a straight line is given in Vol. I, n. 239. For Leibniz's criticism of Euclid and his own definition see No. 27, II, and nn. 256 and 258. See also the New Essays, Book IV, 12, 4.

25. This passage, somewhat anticipatory of Kant, involves the criteria for the reality of phenomena stated in No. 39. It can be reconciled with the monadology only when it is remembered that the rational principles upon which phenomena are well founded are themselves the metaphysical basis for God's creation of individuals.

26. Conscientia. The term is obviously used here in the sense of intellect or understanding.

27. The allusion is to Descartes's vicious circle in validating our general principles by a reference to God's moral nature.

28. See Vol. I, n. 226.

29. The first draft contained an example which was later deleted. "For example, assume a definitum A whose definition is 'an absolutely necessary beast.' A is shown to exist in this way: whatever is absolutely necessary exists, by an indubitable axiom. A is absolutely necessary, by definition. Therefore A exists. But this is absurd. The reply to it must be that this definition or concept is impossible and hence cannot be admitted as an assumption."

    Cf. n. 188 in Vol. I. Leibniz here is so confident of the basic principle that possible concepts strive for existence that he uses it to infer the contradictory nature of terms which do not exist. This, however, once more threatens his distinction, worked out against Descartes and Spinoza, between possible notions and compossible ones which, if the best possible, will exist.

30. See Nos. 51 and 67, Secs. 37-39.

31. To Mersenne, July 1, 1641 (Correspondence, ed. Adam and Tannery, III, 392). Leibniz had repeatedly refuted this view of ideas from the Paris period on (see Nos. 21, 25, and 33 and New Essays, Book IV, 10, 7).

32. The first draft added: "Meanwhile it is very true that there is the idea of God in us, because it is most true that God is possible and hence existent and in both senses known by us. In a certain way all ideas are innate in us, nor can the senses do anything else but to turn the mind to them, as is shown elsewhere."

33. The comment is directed at Descartes's tendency to atomize the contents of consciousness (cf. *Meditations,* Part III; *Principles,* Part I, Art. 21), which led his school to interpret each state as a distinct divine creation. See also the beginnings of the correspondence with De Volder (No. 55). Leibniz's conception of force provides an internal continuity and self-determination to the temporal processes of the mind.

34. See No. 50, below.

35. On the doctrine of attribute see No. 35, Sec. 8, and nn. 183 and 185. Applied to individual substances, the concept of attribute can mean only the law of the individual series, and Leibniz points out that this is incapable of a complete generic definition by us. For the essence of a particular creation is beyond finite analysis, and generic definitions are possible only of partial concepts.

36. The original version adds: "Meanwhile it is very true that matter and mind are entirely different, as we will sometime show better."

37. The original version adds: "Meanwhile we are right in saying that colors and heat are in things, when we mean by this the foundations of these pehnomena."

38. The allusion is to Euclid's *Elements,* Book v, where the principles of proportion are developed.

39. Leibniz had originally added: "I have elsewhere discussed wherein the reality of material things consists. See also Part I, Article 4."

40. Internal place is for Descartes the volume of a body; external space, the position of this volume within a larger whole. He then defines motion as change of this external position in relation to near-by bodies.

41. Addition in the first draft: "For the rest, I shall sometime make clear that a material mass is itself not a substance but an aggregate resulting from substances, and that space is nothing but the common order of all coexistents, as time is that of things which do not coexist."

42. Addition in the first draft: "We conclude that there are none on other grounds."

43. Addition in the first draft: "These opinions may be true, however, on other grounds."

44. The problem of the relativity of observed motion is thus, at this point in Leibniz's thought, an argument for an internal force in bodies. The point is further discussed in the correspondence with Huygens (No. 43) and in the *Specimen dynamicum* (No. 46).

45. Original addition: "although a perfectly quiescent body is in fact never found."

46. Leibniz's historical notes on the origins of the resolution of motions (and later, forces) are in general sound. Kepler's work is *Ad Vitellionem paralimpomena, quibus astronomiae pars optica traditur* (1604).

47. See Vol. I, No. 34. His argument will be often restated (cf. Nos. 46 and 55).

48. Leibniz's acknowledgment that the quantity of motion is conserved in the case of bodies which do not reverse their direction anticipates his own more general principle of the conservation of quantity of progress, which differs from Descartes's principle in considering the algebraic, not the arithmetic, sum of motions (see No. 46 and n. 97).

49. Kepler, *Epitome astronomiae Copernicanae* (1620), Book IV.

50. *Durus*. More exactly, Leibniz must mean bodies with perfect elasticity. Compare the discussion of Articles 56 and 57 below. See n. 338 in Vol. I on the laws of impact.

51. As BC. points out (I, 316), G.'s text is in error in reading *assequens* for *praecedens*.

52. In other words, if m is the mass and v the velocity of the first body before impact, and V its velocity after impact; and m_1 the mass and v_1 and V_1 the velocities before and after impact of the second body, which overtakes the first, then $V_1 = 0$ when $(m - m_1)/m = 2v/v_1$. Leibniz's formula can be derived from the principle of the conservation of *vis viva* and of momentum (or quantity of progress), both of which are true only in the case of perfectly elastic bodies:

$$mv^2 + m_1v_1^2 = mV^2 + m_1V_1^2; \tag{1}$$

and

$$mv + m_1v_1 = mV + m_1V_1, \tag{2}$$

by dividing (1) by (2), solving for V in the quotient, substituting for V in (2), and then resolving the resulting equation for the case $V_1 = 0$.

53. These conclusions follow from the general formula for V_1 in n. 52, for the cases, respectively, of $m < m_1$, $m = m_1$, and $m > m_1$, with $v = 0$.

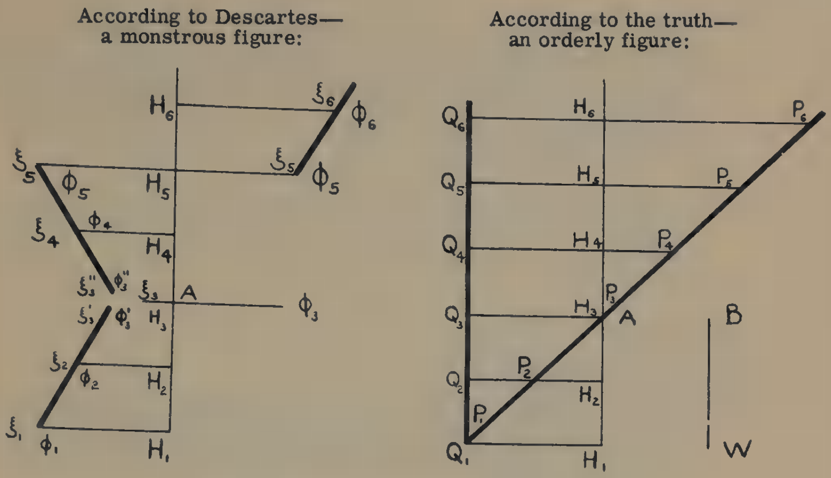
54. See Descartes to Mersenne, January 21, February 7, and March 4, 1641 (*Correspondence*, ed. Adam and Tannery, III, 287 ff., 300 ff., 318 ff.).

55. See Vol. I, No. 37.

56. G. has *B*, an obvious error.

57. To this article Leibniz offers the following long note (here somewhat abridged) giving a graphical representation of the discontinuities in Descartes's laws and the continuity in his own.

Representation of the rules of motion in the case when the colliding bodies are equal.



According to Descartes—
a monstrous figure:

According to the truth—
an orderly figure:

Explanation of the figure for Article 53, second part

Before collision the motion of body B is BW, that of C is AH_1, AH_2, etc.

After collision the motion of B is $H\phi_1$, $H\phi_2$, etc., according to Descartes; and HP_1, HP_2, etc., according to me.

After collision the motion of C is $H\xi_1$, $H\xi_2$, etc., according to Descartes; and HQ_1, HQ_2, etc., according to me.

H below or above A, and P, ϕ, Q, and ξ to the right or to the left of AH, signify the same or the contrary direction, respectively, as that taken by B before collision.

ϕ_1, ϕ_2, ϕ_3, ξ_1, ξ_2, ξ_3, are from Descartes's Rule 7; ϕ_3, ϕ_4, $\phi_{(5)}$, ξ_3, ξ_4, ξ_5, are from his Rule 3; ϕ_3, ξ_3, are from his Rule 6; and ϕ_5, ξ_5, from his Rule 6. My lines and Descartes's have only two out of an infinity of cases in common: H_1 and H_5.

58. "Schediasma de resistentia medii et motu projectorum gravium in medio resistante," Acta eruditorum, January, 1689.

59. So G., IV, 391. BC. suggests reading "transitum a mathematica ad naturam." But G.'s reading is defensible in view of the narrower meaning of naturalis just below. The concept of force is metaphysical in Leibniz but appears in science in the form of derivative force.

60. Paracelsus was the source both of Van Helmont's archeus (see n. 352 in Vol. I) and of the animistic views of Robert Fludd (1574-1637) in his Philosophia mosaica (1638). These views are more fully criticized in Nos. 53 and 61.

No. 43. Correspondence with Huygens

61. In his letter of July 11, 1692 (GM., II, 139 ff.), Huygens postulated an

infinite hardness in the parts of matter, in direct opposition to Descartes's theory that all the properties of bodies arise from motion and that firmness in particular comes from the grinding-off of corners and parts, which leaves spherical bodies with rapidly moving splinters between them (*Principles*, Part III, 49-52, 87-88). Huygens himself proposed an explanation of cohesion based upon several factors, among them external pressure.

62. Leibniz is driven by his search for generalized explanations to explain gravity in terms of a plenum and vortical motion and to carry out the analogy to light, magnetism, and firmness. This effort is continued until the correspondence with Clarke at the end of his life (No. 71).

63. The pun is Leibniz's.

64. See No. 42, Part II, Arts. 54 and 55.

65. Leibniz's basic objection is that atoms violate the principles of sufficient reason and of continuity, since the transition from aggregated bodies to simple atoms carries over materialistic properties such as extension and firmness but involves a leap from one set of laws of motion and cohesion to another.

66. In his letter of May 29, 1694, Huygens selected another remark in the *Critical Thoughts on the General Part of the Principles of Descartes* for comment. Leibniz had implied (Part II, on Art. 25) that Descartes's theory involved the relativity of motion and that, to determine the subject of motion, one must go beyond it to force. Huygens erroneously ascribed to Leibniz the view that it is absurd to regard motion as relative and asserted that he himself held to such a relativity and believed that Newton would change his opinion in the second edition of the *Principia*.

67. In his last letter, Huygens had mentioned working on "un petit traité en matière philosophique." This was probably the *Cosmotheoros*, published posthumously in 1698.

68. Leibniz's plan to write a differential and integral calculus was not carried out, though he worked on the manuscript and hoped to have it published at the Louvre in Paris (No. 49). The first standard text was by the Marquis de l'Hospital himself, the *Analyse des infiniment petits pour l'intelligence des lignes courbes* (1696). The *Opera mathematica* (Oxford, 1693 ff.) of John Wallis contained two letters of Newton with an account of his own methods. This paragraph, the postscript, and the following letter are significant for Leibniz's opinion on the value and independence of the two methods ten years before Newton's pupil, John Keill, actually pushed the charges of plagiarism.

69. Fatio de Duillier, a Swiss mathematician living in London, was the first to imply (in 1699) that Leibniz's calculus was not original with him. He had been incensed by Leibniz's failure to mention him in an article on the solutions to the brachistochrone problem in 1697. The charge of plagiarism became serious, however, only when John Keill renewed it in 1705.

70. In his reply on August 21, 1694, Huygens supplied the notes on Wallis' work and said that he had held to the absoluteness of motion until the last two or three years but that he could not agree with Leibniz that each body nevertheless has its own definite degree of motion.

71. "We too could have done this."

72. This paper was printed by Gerhardt (GM., VI, 144-47) as a note to the *Tentamen de motuum coelestium causis.* Leibniz's appeal to Rome was grounded upon the relativity of motion.

No. 44. From the Ethical and Legal Writings

73. Cf. n. 106 in Vol. I. *Jus* may be translated either as Right or as Law, depending upon the context.

74. Carneades' statement is found in Cicero *De rep*. iii. 23, though Leibniz seems to have taken it from Grotius.

75. Leibniz here anticipated the bitter debate on the issue of disinterested love, which broke out between Fénelon and Bossuet (cf. n. 324 in Vol. I, after the appearance of the former's *Explication des maximes des saints sur la vie intérieure* in 1697). Fénelon asserted that pure love must "exclude every interested motive" and that "the soul must make the absolute sacrifice of its self-interest for eternity." The theological conflict which followed led to Fénelon's banishment from the court in August, 1697, and the pope's condemnation of the *Explication* in March, 1699 (see A. Cherel, *Fénelon ou la religion du pure amour* [1934]). On Leibniz's conception of the relation between law and theology see the concluding section of No. 1 in Vol. I.

76. See No. 2 in Vol. I. The three precepts of Law are in Ulpian *Institutes* i. i. 3.

77. Hugo Grotius, *De jure belli et pacis*, I, i, 5. We use Whewell's translation of the terms *facultas* and *aptitudo*, which correspond in general to "strict" legal right and to moral right, respectively.

78. The following paragraphs are not given by G. but are taken from the *Codex juris gentium diplomaticus* (Hanover, 1693) itself. The Preface does not have numbered pages.

79. From the third page (unnumbered) of the Preface to the *Mantissa codicis juris gentium diplomatici* (Hanover, 1700), a supplementary miscellany of political and diplomatic documents from the medieval and modern periods.

80. See n. 75.

81. For the quietist movement of the seventeenth century and Miguel de Molinos see n. 344 in Vol. I. Valentine Weigel, Evangelical pastor and mystic (1533-88), wrote many mystical works and had attributed to him many which he did not write. New editions of works attributed to him were appearing at Amsterdam and at Frankfurt in the years at the end of the seventeenth and the beginning of the eighteenth century. The *Cherubinischer Wandersmann* of "Angelus Silesius" appeared in its second edition (the first to bear this title) in 1675.

82. Fénelon's drama *Télémaque* had appeared in 1699.

83. The date of this paper, written in German, is uncertain, though Guh. DS. places it in the last decade of the seventeenth century, "when Leibniz stood at the height of his philosophical convictions." He had written a French "de la Sagesse" in the Paris period (G., VII, 82 ff.) and was occupied with such statements of his ethics throughout his life. This paper is obviously addressed to "persons of rank" and contains echoes of the tragedies undergone by the House of Hanover at this time.

84. Family disasters were striking at the court of Hanover in the early nineties: the deaths of the Princes Frederick August and Karl Philip in battle in 1690; the abortive attempt of Maximilian, the youngest son of Ernest August, to break the newly established law of primogeniture, which failed in 1691; and the notorious Königsmark incident leading to the divorce of George Louis, later George I, king of England, and to the exile of his wife Dorothea, in 1694.

85. These are Leibniz's notes on John Felden, *Elementa juris universi et in specie publici Justiniani* (Frankfurt, 1664), I, i. Felden's jurisprudence is Aristotelian and directed against Hobbes.

No. 45. ON THE CORRECTION OF METAPHYSICS AND THE CONCEPT OF SUBSTANCE

86. In the *Responsio ad secundas objectiones* (ed. Adam and Tannery, VII, 160-70).

87. The difference between Leibniz's conception of an originating force and the Scholastic concept of a capacity or the possibility of action is thus clear. But as *primary force* something of the Scholastic notion is retained in his system, since this force inheres potentially in the concept of the individual. The concept of force is more fully developed in No. 46, Part I.

88. See No. 47.

No. 46. SPECIMEN DYNAMICUM

89. See No. 45, which had appeared in the same journal the preceding year.

90. The criticism here implied of the occasionalists and Malebranche becomes explicit in the *New System* (No. 47) and even more so in *On Nature Itself* (No. 53). The continuous miracle imputed to the occasionalists was involved in the denial of any proper activity according to law within created beings themselves.

91. Primitive force thus belongs to the realm of metaphysics, not of mechanica science. But it inheres in the individual monads and the laws of their functional dependence, which would be revealed if physical analysis and synthesis could be completed.

92. On the nature of the corpuscular philosophy see Vol. I, n. 394. It is abused by any theory which regards mechanism as ultimate or applicable to substa itself. The "crude notion of a corporeal substance" advocated by Descartes thus exceeds the limits of a sound corpuscular philosophy by reducing substance to extension.

93. *Materia prima* is here defined in relation to the quality of resistance and inertia in the phenomenal body. Contrast No. 39, and n. 11, where it is related to the monad or individual substance. This dual function of *materia prima* appears throughout the subsequent discussion of matter. Cf. Introduction, Secs. III and VII. Secondary matter, on the other hand, includes the physical property of inertia and resistance in the composite body involved in physical transactions.

94. On Leibniz's concept of mass see nn. 51 and 359 in Vol. I. Mass is not equivalent to matter but is a quantitative measure of inertia or *materia prima* as experienced in *materia secunda*. But compare the distinction between *moles* and *massa* in n. 199 below.

95. See n. 331 in Vol. I. Leibniz now defines momentary motion and aggregate motion in the sense in which he used quantity of motion and quantity of force in 1686. Every body has a velocity at a particular moment of time: $v = (ds/dt)$. The product of the mass by this velocity is here called the quantity of momentary motion, or merely "motion": $mv = (mds/dt)$, while the quantity of motion over a period of time would be the integral:

$$m\int_0^t \frac{ds}{dt}dt = ms\,.$$

But, since distance is proportional to v^2, this is Leibniz's own quantity of force as defined in No. 34.

The following table presents the mathematical equivalents of Leibniz's concepts:

Leibniz	Modern	Formula
Conatus, momentary velocity	Velocity (vectorial)	$v = \frac{ds}{dt}$
Impetus, momentary motion (quantity of motion for Descartes)	Momentum	mv
Quantity of motion for Leibniz	. . . .	$m\int_0^t vdt$
Dead force (solicitation)	Force of acceleration (cf. potential energy)	$a = \frac{dv}{dt}$ ma
Living force	*Vis viva* (cf. kinetic energy)	$m\int_0^t vdt = m\int_0^t \frac{d2}{dt}dt = ms$ or mv^2
i. In a single body		
ii. In a compound system		
a) Absolute or total force	. . . .	$\Sigma\, mv^2$
b) Progress of direction	. . . .	$\Sigma\, mv$

96. I. e., force of acceleration.

97. Not only the total living force of a material system is conserved, therefore, but also (1) the internal relative force of its members with regard to each other and (2) the total directive progress of the system. The result of (1) is that the center of gravity of the system is not changed by the motions of its component members. The principle of the conservation of direction of progress differs from Descartes's principle of the conservation of quantity of motion in considering the algebraic, not merely the arithmetic, sum of the progressive motion (mv) of its members; thus motion in opposite directions would carry opposite numerical signs (cf. n. 48). In this connection see H. Poincaré, "Note sur les principes de la mécanique dans Descartes et dans Leibnitz," in Émile Boutroux's edition of *La Monadologie* (Paris, 1881), pp. 225-31.

98. That is, to the derivative of the distance, ds/dt, or v. See n. 332 in Vol. I.

99. See No. 42, Part II, on Arts. 40-44. Among Descartes's reifications of modal or conceptual differences which Leibniz had criticized are the distinction between rest and motion, the reduction of direction to the same and contrary motions, and, now, the absolute separation of direction and speed. Descartes's distinction had saved his interactionism. Leibniz has just asserted

that both force and direction of motion are conserved in a material system, and this implies that mind can effect neither; parallelism is thus inevitable.

100. See Vol. I, n. 333. Johannes Marcus Marci von Kronland, *De proportione motus* (1639); Ignace Gaston Pardies, *Discours du mouvement locale* (1670)

101. On Huygens see Vol. I, nn. 331 and 337. It was the laws of motion of Huygens and Wren, formulated in 1668 in response to an invitation of the Royal Society, which occasioned Leibniz's own first efforts to develop laws of motion in 1669 (see Kabitz, *Phil. des jungen Leibniz*, pp. 65-68, 135-48). Mariotte had further developed some of Wren's work.

102. See Vol. I, n. 361.

103. Henry More's *Opera omnia* reached Leibniz soon after publication in 1679, but his influence is probably negligible beyond a few figures of speech which Leibniz appropriated from him. His argument that force and motion are due to a hylarchic principle which imparts an "essential spissitude" to the bodies in which it inheres is developed in the *Metaphysical Enchiridion*, chap. xiii, scholium. For a further criticism see No. 63, below. Cf. Vol. I, nn. 63 and 352; Vol. II, n. 60.

104. William Molyneux's *Dioptrica nova* appeared in two volumes (1692 and 1709). His reference was to the "Unicum opticae, catoptricae, et dioptricae principium," which Leibniz published in the *Acta eruditorum* in 1682 (see No. 50).

105. Though the following argument has already been given three times (Nos. 34, 35, and 42), it is here developed with an emphasis upon methodology, which is a special case of the general method of analysis and synthesis. In No. 34 Leibniz attributed his method of analysis and the substitution of equivalents to Huygens' analysis of the compound pendulum (see Vol. I, n. 337).

106. Reading *metu* (Dut.) for *motu* (G.).

107. Reading *unus* for *minus* (G.).

108. Dut. adds "in the month of May." The second part was not published, however. The dynamic interpretation which Leibniz gives of his principles in this second part should be compared with their a priori logical exposition in the "First Truths" earlier (No. 30).

109. The *New System* was published this same year (No. 47).

110. It is not clear that the term *ratio* here implies the mental nature of these relations.

111. See the last letter in No. 43, and n. 72, for Leibniz's attempt to have his reconciliation of the two views accepted at Rome.

112. Leibniz's graph is in n. 57 to Art. 53 of No. 42.

113. See Vol. I, No. 37. Malebranche undertook to correct his laws of motion as presented in the "Recherche" in his *Traité des lois de la communication des mouvements* (1692).

114. The passive force involved here corresponds to relative or proper force as defined in Part I, not to directive or total force. The instance of the ship (the prototype of popular expositions of relativity?) makes this clearer

115. To "save phenomena" means not merely to avoid theories which contradict them but to provide analyses (here causal) that explain them.

116. This criticism is directed at both Newton and Huygens, who had held that circular motion is an argument for absolute motion (see No. 43, II, III).

No. 47. A NEW SYSTEM OF THE NATURE AND THE COMMUNICATION OF SUBSTANCES

117. Leibniz soon found it necessary to deny that he had a system (see Nos. 49, I, and 54).

118. Leibniz notes, "Mr. Arnauld" (cf. Vol. I, Nos. 35 and 36).

119. In his final revision Leibniz altered the last two sentences as follows: "Now a multitude can derive its reality only from true unities which have some other origin and are entirely different from mathematical points, these being merely the extremities of what is extended, and modifications of which it is certain the continuum cannot be composed. To find the real unities, therefore, I was forced to have recourse to a *real and animated point*, so to speak, or an atom of substance which must include a certain active form to make a complete being."

120. See No. 45 and n. 87.

121. Leibniz is in error in ascribing to Thomas Aquinas the doctrine of the indivisibility and immortality of all souls. In the *Summa theologica*, Part II, chap. 82, Aquinas argues against the immortality of beasts, holding that only perfect souls are indivisible.

122. Later revision: "every simple substance."

123. Later addition: "through the very order which God has put in them."

124. Later revision: "brute souls."

125. That is, abstracted qualities whether regarded as immaterial or material, like the Scholastic "species volantes," which are passed from one substance to another (see Vol. I, n. 368).

126. Pierre Sylvain Regis, *Cours entier de philosophie ou système général d'après les principes de Descartes* (1691). Nicolas Hartsoeker, Dutch microscopist, published an *Essai de dioptrique* in 1694 in which he developed an atomic theory. Regis criticized Leibniz's attacks on Descartes in 1697 (G., IV, 333-36), and Hartsoeker later corresponded with Leibniz on problems in the philosophy of nature (G., III, 488-90).

127. In the "Doctrine of a Single Universal Spirit" (1702) (No. 58), Leibniz attributes this account of Democritus' theory of resuscitation to Plotinus. Pliny had ridiculed the concept as "put forth by Democritus, who did not himself come to life again."

128. Reading *cours* with Erd. and Sch., instead of *corps* (G.).

129. *De coelo* iii. 1. 298*b*.

130. Fontenelle's *Entretiens sur la pluralité des mondes* was published in 1686.

131. See Vol. I, n. 288. Cordemoi had supplemented Descartes with an atomic and an occasionalistic theory.

132. Metaphysical points are not spatial in Leibniz's mature thought, though he has not yet asserted, in 1695, that there is no absolute motion, but only that it cannot be known in a closed physical system. The spatial correlates to the three kinds of points are perceptual space to physical points, conceptual space to mathematical points, and the complex harmon of representational perspectives or points of view to metaphysical points.

133. Leibniz probably alludes here to Descartes's letter to Elizabeth, June 18, 1643 (*Correspondence*, ed. Adam and Tannery, III, 690-91).

134. Cf. No. 42, Part II, Art. 25, and No. 43. The allusion to relativism in astronomy is to the interpretations of celestial motions by Copernicus, Ptolemy, and Brahe, which Leibniz was interested in harmonizing through a phenomenalistic interpretation (cf. n. 72).

135. In 1697 Leibniz wrote brief replies to three critics of his *New System*—Foucher, Beauval, and Hartsoeker. Since the most thorough criticism was that of Bayle, and Leibniz's answer is most extended (No. 52), we print only one of the "three explanations" made earlier—the "second explanation" sent to Beauval, editor of the *Histoire des ouvrages des savants*.

136. The figure of the two clocks is not original with Leibniz but was in general use among the occasionalists. Its first use is generally attributed to Geulincx, *Ethica*, I, ii, 2, n. 19, though Leibniz need not have secured it from that source. The figure is not a fortunate one for Leibniz, since it throws no light upon the representative and functional nature of the relations between monads and also neglects the distinction between the passive and active roles of the monads in the divine harmony.

137. It is noteworthy that the adjective "pre-established," so popular in the descriptions of Leibniz's system, does not appear until late in his thought, and then with particular reference to the mind-body problem. Any deistic implications are inconsistent with the immediacy of God in the perceptions and appetites of the monads. Leibniz was, however, already charged with deism by his contemporaries (see the *Philosophical Transactions of the Royal Society, 1714-1716*, p. 224).

No. 48. *Letter to Gabriel Wagner on the Value of Logic*

138. On Huet see Vol. I, No. 31, and n. 299. Huet had written a *Censura philosophiae Cartesianae* in 1689, in which he charged that Cartesianism was subversive to the church. The work is discussed in Leibniz's corresp ence with Nicaise.

139. Peter Ramus (1515-72), Calvinistic philosopher, attacked the Aristotelian logic as artificial and remote from the natural logic of the mind and propo a logic of discovery and judgment which he conceived as being closely related to rhetoric. The Semi-Ramists or Philippo-Ramists sought a mediating position in the controversy between Ramists and Aristotelians (or in the Protestant universities, Philippists, after Melanchthon). Leibniz's combination, a little later in the letter, of Aristotelian topics with Ramist loci suggests the influence of Semi-Ramism.

140. The German terms used by Leibniz are *Beweisslichkeiten* and *Beleglichke* They correspond in general to the two dimensions of thought—ratiocinatio and representation—corresponding to the formal relational and the empir aspects of knowledge (see Vol. I, Introduction, Sec. V).

141. On relations *in recto* and *obliquo* see Vol. I, n. 237. Leibniz's extension of the predicables beyond Porphyry's, to include the oblique relations of

subjects, points to a fundamental difficulty in his theory that the predicate is included in the subject in every true affirmative proposition.

142. Vincent Placcius (1642-99), lawyer and patron of scholars, was engaged in correspondence with Leibniz at this time.

143. See The Art of Thinking, Book III, chap. i. On Leibniz's knowledge of the authorship of this work see Vol. I, Introduction, n. 28.

144. The classification of the valid modes of the four figures was one of the more important applications of the first two problems in the Art of Combinations (1666) (Vol. I, No. 1).

145. The allusion is probably to the correspondence with Papin on the Cartesian theory of gravity and the conservation of quantity of motion, which resulted in Leibniz publishing "De legibus naturae et vera aestimatione virium motricium contra Cartesianos," Acta eruditorum, September, 1691 (cf. Cout. L., p. 2, n. 1).

146. See Vol. I, n. 99. Both Jung and Felden had been mentioned with approval in the letter to Thomasius in 1669 and the Preface to Nizolius in 1670.

147. Aphthonius of Antioch, a rhetorician of the late third and early fourth centuries, edited the Progymnasmata of Hermogenes of Tarsus as a textbook. The De civilitate morum puerilium (1530) was the best known of Desiderius Erasmus' pedagogical works. Both books were still widely used as schoolbooks in the seventeenth century.

148. All inference is therefore synthetic in matters of fact, and predicates are only incompletely or partially in their subjects.

No. 49. Letters to Des Billettes

149. Francis Schooten's Exercitationes mathematicae librae V (1657) contained Huygens' paper De ratiociniis in aleae ludo, the beginning of the modern study of probability. The gambler mentioned was Antoine Gomboult, the Chevalier de Méré, as the account in the New Essays, IV, 16, 9, shows. On Leibniz's conception of the importance of games see n. 39 to the Introduction.

150. See No. 47.

151. See n. 68.

152. The Treaty of Ryswick was signed September 20, 1697.

153. The first aneroid barometer was patented by Vidié in 1845.

154. To the inquiry about Pascal's mathematical manuscripts, Des Billettes replied as follows (May 28, 1697): "There remains only the one Perier who is priest and dean of some chapter in Clermont in Auvergne, his birthplace, and a sister worthy of them and their uncle [Pascal]. You need not expect the works of the latter. Either they would have published them, or they did not judge them fitting to be brought to light."

155. Jean Paul Bignon, abbot of St. Quentin, was president of the Academy and director of the Royal Library, one of the co-founders of the Journal des savants. On the work which Leibniz sought to have published at the Louvre see n. 68.

156. On the controversies already in process about the validity and clarity

of Leibniz's calculus of infinitesimals see the introduction to No. 56, below.

No. 50. TENTAMEN ANAGOGICUM

157. See Introduction, Sec. V and n. 36.

158. The text as given in G. begins with what is really a note added later by Leibniz (Cout. OF., p. 587). This note is as follows:

"Whatever leads us to the supreme cause is called anagogical by philosophers as well as theologians. So we begin here to show that no other reason can be given for the laws of nature than the assumption of an intelligent cause. Or we show also that in the investigation of final causes there are cases in which it is necessary to consider the simplest or most determinate, without distinguishing whether this is a maximum or a minimum; that the same thing is to be seen in the differential calculus; that the general laws for the direction of a ray, derived from final causes, give a beautiful example of this, without distinguishing whether the ray is reflected or refracted or whether the surface is curv or a plane. Certain new general theorems can be derived which apply equally to refraction and reflection. We show that the analysis of the laws of nature and the investigation of causes lead us to God; and how, in the method of final causes as in the differential calculus, we do not consider maxima and minima only, but the most determined and most simple in general."

Leibniz also notes: "See if some of these propositions are already to be found in Barrow or elsewhere."

159. That is, the faculty of interpretation within the limits of sensory perception (see Vol. I, n. 33).

160. This is a clear allusion to the brachistochrone problem propounded by John Bernoulli in 1696; Leibniz restates the principle used by James Bernoulli in his solution: "If a curve has a certain property of maximum or minimum, every portion or element in the curve also has the same property" (see Mach, The Science of Mechanics [5th English ed.], pp. 521-29).

161. Leibniz follows the Aristotelian meaning of the term (Nic. Ethics i. 1) which applies to final causes or ends as explanatory of subordinate ends. Leibniz's architectonic therefore differs from Kant's in being metaphysical as well as methodological, though both rest upon a harmony of forms or possibilities.

162. Leibniz's meaning in this difficult paragraph is made clearer by his actual analyses of reflection and refraction which follow, in which he uses the plane tangent at the point of incidence in place of the curved reflecting or refracting surface itself. His argument rests upon the old discovery that maxima or minima involve in their determination the reduction of two equal values to a single one. This principle he views as an instance of the metaphysical principle of maximal determination or of the optimum.

163. Leibniz notes, "Mr. Molyneux" (see n. 104). On Fermat's interpretatio of the problem see Mach, The Principles of Physical Optics (New York, 1925), p. 34.

164. A line drawn from a vertex of a triangle dividing the opposite side into segments proportional to the adjacent sides bisects the angle at the vert

165. Leibniz's marginal note: "From this another theorem can also be derived which is common to catoptrics and dioptrics, and which seems most elegant to me. It is as follows. If two points are taken in a broken ray in such a way that the line which joins them is divided equally by the perpendicular to the surface of separation, the ratio of the two rays is always constant and proportional to the resistances of the media. For example, if *F* and *G'* are taken so that *CP'* cuts *FG'* in two equal parts *FP'* and *G'P'*, the ratio of ray *FC* to ray *CG'* will always be constant, namely, as *f* to *g*. For this reason they are equal in the same medium, which is the case in reflection."

166. That is, the sines of angles *FCL* and *GCP*, since *CF* = *CG*.

167. The equation of G. is obviously incorrectly copied.

168. Iceland spar, whose property of double refraction had been discovered by Huygens and was discussed in the correspondence of Leibniz with him in 1694.

169. "Things which are contrary to moral principles, we ought also to believe we are unable to do."

170. See Vol. I, No. 37.

No. 51. ON THE RADICAL ORIGINATION OF THINGS

171. The fuller and more exact meaning of this title, here translated literally, is "On the Process by Which the World Comes into Being from Its Roots," that is, "On the First Principles of Creation."

172. Both G. and E. have *a priore*; Professor Paul Schrecker is authority for reading *a priori*, with the Hanover manuscript.

173. Reading *existentiam* (with E.'s errata) for *essentiam* (G.).

174. For Leibniz's more specific argument on this point see the preceding selection (No. 50), particularly the closing paragraph.

175. The example apparently alluded to is the catenary, discovered by John and James Bernoulli, and solved by Leibniz, Huygens, and others in 1696. It was easily solved as a problem in maxima (see Mach, *The Science of Mechanics*, pp. 85-89).

176. The barbarism is the word *realisentur*. The verb occurs frequently in crucial passages in the correspondence with Des Bosses (see n. 308 below).

177. The allusion is to the *Theory of Abstract Motion* (1671) (No. 8). Leibniz explains his change of opinion in detail in No. 46, Part I.

178. *Physica*. The extension of nature to include human purposes and actions is characteristic of much of Leibniz's writing (see n. 66 to the Introduction).

179. Reading *erga* (Erd.) for *ergo* (G.).

No. 52. CLARIFICATION OF THE DIFFICULTIES WHICH MR. BAYLE HAS FOUND IN THE NEW SYSTEM OF THE UNION OF SOUL AND BODY

180. These references are to the *New System* itself and to the first two of the

short explanations, the second of which is given in No. 46, Part II (cf. n. 135).

181. Meanwhile Leibniz has not answered Bayle's criticism, which Arnauld (see No. 36) and Foucher had already suggested. This concerns the unnecessary character of the physical world, if every modification of the soul arises solely out of its own nature. Leibniz does return to this problem briefly later in this essay, as well as in Nos. 53 and 62 and elsewhere. His basic argument for the existence of an external world of monads and a universal harmony is based upon the principle of perfection and plenitude (see his argument for the existence of other minds in No. 39).

182. The ambiguity of Leibniz's definition of miracle (as that which exceeds the power of creatures) is shown by his inclusion of Newton's theory of "attraction" among miraculous explanations. The test of what lies within the power of creatures (or of nature) is never indicated; here his inclination to restrict motion, as did the Cartesians, to motion imparted by impact led him to views hardly consistent with his own metaphysics.

Leibniz did not take into consideration the celebrated general scholium to Book III of Newton's _Principia_, in which the assumption of an an attractive power in bodies is rejected, for the obvious reason that it appeared only in the second edition in 1713.

183. I. e., with a constancy or invariance in its states, analogous to a curve each part of which is similar to every other part, that is, a straight line.

184. The quadratrix, first discovered by Hippias of Elis, is a compound of a closed rotary and an open progressive motion (see Cantor, _op. cit._, I, 195-97, 246-48). To construct the figure described by Leibniz, let the center of the circle move on the _Y_-axis.

185. In this article Bayle had discussed the inconsistency of infinite divisibility with perceptual limits to analysis and had suggested that solid physical figures, as well as plane geometrical ones, have only "ideal" existence.

186. Cf. n. 201, below, and the text corresponding to it in No. 53.

No. 53. ON NATURE ITSELF

187. The full title adds: "To Serve To Confirm and Illustrate the Author's Dynamics."

188. The following bibliographical notes may make the references in the essay clearer: Robert Boyle's _Tractatus de ipsa natura_ (1682) formulated the mechanical conception of nature which Boyle repeated in his _Free Inquiry_ of 1686. On it Sturm based his _De naturae agentis idolo_ (1692), to which Schelhammer replied in _Natura sibi et medicis vindicata_ in 1697. Sturm's reply, _De natura sibi incassum vindicata_ (1698), is the work to which Leibniz here refers as the "Apologetic Dissertation." The _Elective Physics_ is Sturm's _Physica electiva sive hypothetica_, published in 1697.

189. On the various vitalistic theories of nature which Leibniz had criticized since 1669, see nn. 63 and 352 in Vol. I and nn. 60 and 103 in this volume. He frequently cited the pseudo-Hippocratic work, _Peri diaites_ (especially in his correspondence with Arnauld), in

connection with his view that animals are never truly generated or destroyed.

190. See Aristotle's *Physics* iii. 1. Leibniz returns to Aristotle's conception of motion at greater length in the *New Essays*, III, i, 9.

191. The two mathematicians were probably John Bernoulli and Christian Huygens, who had died in 1695. See the letter to Bayle, December 27, 1698 (G., III, 57), and Gueroult, *Dynamique et métaphysique leibniziennes*, chap. iv, esp. pp. 98-109.

192. See No. 50 and n. 104 on Molyneux.

193. "Let the earth produce and animals bring forth their kind."

194. The allusions are to the phrases "let there be" and "it is good" in chapter 1 of Genesis.

195. The sharpening of Leibniz's condemnation of Spinoza since the papers following 1678 is conspicuous.

196. The conversion of the proposition *actiones sunt suppositorum* (see Vol. I, Introduction, Sec. V, and n. 85 in the text) into "every substance acts" is in need of empirical grounding; Leibniz's entire physics, biology, and psychology are efforts to do so. It is difficult to see, however, how the principle really establishes pluralism. Leibniz merges two things—God's impression of a law of individuality and of force upon creatures.

197. Louis de la Forge anticipated occasionalism in his *Traité de l'âme humaine, de ses facultés et fonctions et de son union avec le corps suivant les Principes de R. Descartes* (1666).

198. The term "monad," which here appears for the first time in these selections, is generally held to have been used first by *Leibniz* in a letter to Fardella on September 3/13, 1696, and to have been borrowed from the younger Van Helmont, who visited Hanover early in 1696 (see L. Stein, *Leibniz und Spinoza*, pp. 209-10). Leibniz had frequently used the terms *monas* and *monachon*, taken from the Greeks, earlier.

199. This is a misleading remark, since secondary matter, as matter, is phenomenal, and only the aggregated monads whose passive force is expressed as resistance or inertia are substantial. Cf. the letter to John Bernoulli in the same year (BC., II, 370-71): "Matter in itself, or mass [*moles*], which may be called *primary matter*, is no substance, not even an aggregate of substances, but something incomplete. Secondary matter [*massa*] is not one substance but a plurality of substances."

200. Leibniz's argument that we have no criterion for individual differences and change without an intrinsic force seems to have full effect against all purely logical and mathematical analyses of the physical world. But it is not clear how it establishes an internal force in addition to motion. His use of the principle of geometric similarity, and its limitation by his injection of change and force, must be understood in terms of his separation of dynamics, phorometry, and geometry after his criticism of Descartes's physics in the 1680's.

201. A reference to Descartes's distinction, in the *Principles of Philosophy*, Part III, Sec. 52, between three levels of matter or "elements of the visible world."

202. See Nos. 45 and 46.

No. 54. *Correspondence with John Bernoulli*

203. Compare the note to the letter to Des Bosses on September 1, 1706 (G., II, 314), on the distinction between a syncategorematic, a hypercategorematic, and a categorematic infinite. This note is translated in the Introduction, Sec. VI (see n. 232).

204. Leibniz obviously anticipates some of Berkeley's later empirical objections to the foundations of the calculus. Though he suggests a number of interpretations in the letter to Varignon (No. 56), his reply to Berkeley could be inferred from his reply to Locke. Ideas are for him not merely objects of the mind, but operators, and the concept of infinitesimal is of this kind.

205. Secondary or derivative force is the variable quantity of activity in the monad, and on the phenomenal level, of any material system and is therefore a function of time, while primary force is the permanent basis or course of action. The two are related as law and its particular values.

206. See Aristotle *Physics* vi. 4. 248*b*, 249*a*.

207. See No. 52.

No. 55. *Correspondence with De Volder*

208. An allusion to Horace *Ep*. i. 32. "One can advance to a certain point, even though nothing further is possible."

209. It is noteworthy that, in describing the extended, Leibniz chooses qualities on rising levels of distinctness and therefore also of well-founded phenomena, beginning with indistinct sense qualities (whiteness) and proceeding through quantitative properties (ductility and weight) to resistance and corporeal force.

210. See Descartes, *Correspondence* (ed. Adam and Tannery), II, 466, 543, 6 Compare Leibniz's discussions of inertia in the fifth letter to Clarke, Sec. 102, and in the *Theodicy*, Part I, Sec. 30. Leibniz does not use inertia, as Newton does in his first law of motion, as an absolute principle of matter but as a quantitative variable which together with velocity determines the constant amount of force in a material system. His physics is thus a phenomenal corroboration of his metaphysics, where force has active and passive aspects.

211. Cf. the *Discourse*, Sec. 21 (Vol. I, No. 35), and Vol. I, n. 36; also the *Specimen dynamicum* (No. 46, I).

212. The close of the letter contains another exposition of the argument agains Descartes that quantity of force rather than of motion is conserved.

213. This letter was not sent but is given here because it replies to De Volder criticisms. The one of the same date which replaced it returns to the physical and empirical problems of substance.

214. Leibniz returns to this problem in his criticism of Malebranche (*Conversation of Philarète and Ariste* [No. 64]), where he makes clear that the difference between duration and extension, on the one hand, and time and space, on the other, is a relational and practical one, the former abstra tions being applied internally to things, the latter externally, and serving the purpose of measurement. But see also the letter of June 21, 1704,

to De Volder (IX, below) and the fifth letter to Clarke.

215. See the first letter of the series. Malebranche expounds this doctrine of creation in the *Entretiens sur la métaphysique* and the *Recherche*, Éclaircissement XV.

216. The discussion of a substantiating chain in the correspondence with Des Bosses (No. 63) turns about the adequacy of this statement.

217. BC.'s German translation renders *perfectio* as "reality." We have not taken this liberty, but the reader *will do* well to remember that for Leibniz and his correspondent the two are equivalent, since primary concepts or essences are the perfections of God.

218. A complete term is thus a concrete one, and an incomplete term abstract. This restates Leibniz's logical view that many real definitions are possible for an abstraction but that there is only one adequate or ultimate analysis possible of a determinate concept.

219. In the light of his rejection of the Scholastic doctrine of influence (cf. n. 6 in Vol. I), Leibniz's use here of the verb *influo* is startling. The context makes clear, however, that he is talking *of* logical and functional dependence and not of efficient causality.

220. It follows therefore that, for Leibniz, independent substances are related in a harmonious complex and that relations are in this sense external to them (cf. *New Essays*, II, xxv, 10: "There is no term so absolute or so detached that it does not include relations so that its perfect analysis leads to other things and even to all other things"). It follows also that the essence of an individual substance, or an individual concept, involves properties not reducible to the properties of the concepts out of which it is compounded.

221. See No. 53. Leibniz has argued more fully in the *Specimen dynamicum* that individual bodies cannot be distinguished except through motion, and hence through their inherent force.

222. Leibniz uses the Epicurean term κύριαι δόξαι. The doctrine of relations expounded in this and the preceding letters (cf. n. 220) is far from unambiguous. If, as he said earlier, all substances are necessarily related yet independent, and if, as he says here, extrinsic relations depend upon internal denominations or relational qualities, he must hold that relations are necessary but not determinative of substance, while the relational qualities upon which the relations depend are thus determinative.

223. A postscript shows that the letter was originally sent in the early winter of 1703 from Berlin but that a copy was sent from Hanover on June 20, 1703, after Bernoulli had reported that he had not received the original, which he was to have forwarded to De Volder.

224. This passage, significantly, identifies the logical and the psychological subject. "Formally" or metaphysically the "I" is a functional law; logically it is a subject which is identical with the "concrete" totality of its predicates; psychologically it is the "thinker," the self-conscious spirit which involves the whole of its perceptions.

225. See Descartes's *Principles of Philosophy*, Part I, Arts. 60 and 61, and Leibniz's comments in No. 42.

226. This distinction between material and abstract analysis, which is effec-

tive in theory but never adequate, though always applicable, to nature, supports Leibniz's distinction between truths of reason and of fact and between the connotative and denotative dimensions of truths of fact. Existing entities are concrete or completely determined; mathematical and logical entities are only partial.

227. Space is thus a phenomenon, but spatiality is a fundamental aspect of the functional relationships between coexistent and simultaneous perceptions of the monads.

228. Leibniz's sudden shifts from mathematical to Scholastic terms (from the law of the series to substances with formal and eminent properties) must not obscure the metaphysical truth here—a creative order which determines its own acts and passive states is a unity which possesses reality beyond these changing modes themselves; it is not merely, after the analogy of spatial conceptions, the aggregate of its parts.

229. Here and elsewhere (cf. the letter to Varignon in No. 56) Leibniz has anticipated the criticisms of Berkeley and other empiricists who seek to limit analysis by *minima sensibilia*; for any empirical problem in which we must pass over into causal analysis, analysis is an endless task.

230. That is, primitive force and its several modes, active and passive.

231. See "Remarque de l'auteur du système de l'harmonie préetablie sur un endroit des *Mémoires de Trévoux*" (G., VI, 595). This appeared in the *Mémoires de Trevoux* for March, 1708, in reply to Tournemine's criticism in the same journal for March, 1704. Leibniz did, however, return to the nature of the metaphysical union in bodies and discuss it extensively with Des Bosses (cf. No. 63 and see also n. 216 above).

232. Thus there is no empirical meaning for infinity as applied to discrete existing beings, but only one of indefinite continuation. The continuum o mathematics, on the other hand, applies only to the realm of possibility (cf. n. 203 above and No. 56).

No. 56. Letter to Varignon, with a Note on the "Justification of the Infinitesimal Calculus . . ."

233. The section enclosed in parentheses was to be omitted in the letter as sent.

234. If Leibniz had more clearly combined his conception of the infinitesimal as a quantity to be taken at will as less than any assignable quantity whatever with his own analysis of series and his functional conception of the law of continuity, he should have been led to the critical concept of limits upon which the calculus was at last theoretically grounded in the nineteenth century by Weierstrass and Cauchy.

235. I. e., a "potential infinite"; see also the letters to John Bernoulli (No. 5 and n. 203.

236. See Vol. I, No. 37.

237. GM. has Suárez.

238. That is, assuming the angle at C to be at the center of a unit circle with radius CX.

No. 57. ON WHAT IS INDEPENDENT OF SENSE AND MATTER

239. For Leibniz's interpretation of Aristotle's doctrine of the common sense as the "mind itself" in reply to Locke see Vol. I, n. 323.

240. The selection of number and figure as examples is significant, since Leibniz used them from the beginning as fundamental categories, subforms of quantity and quality, upon which to base and to extend mathematics, particularly geometry and the art of combinations (see Nos. 1, 27, and 70).

241. Leibniz's distinction between imagination and sensation itself marks a point of deviation from Locke, since he emphasizes the dependence of the former upon the common sense and therefore its close relation to reflection and understanding.

242. At about this time Leibniz was developing his theory of apperception (probably suggested by the reflexive form s'appercevoir, which Coste used to translate Locke's perceive). Apperception or reflection is the basis of understanding, for without it there would be no perception of the content of perceptions and therefore no gound upon which to discover the universal principles of reason operative in the mind. While memory is the precondition of consciousness for Leibniz, apperception is the essential relation involved in the continuity of consciousness.

243. Reading exempte for exemple (G.).

No. 58. REFLECTIONS ON THE DOCTRINE OF A SINGLE UNIVERSAL SPIRIT

244. Leibniz's easy identification of the differing positions of these men is inexact. Pomponazzi (De immortalitate animae [1516]) explicity rejected the Averroistic doctrine of a single active intellect, and Cardinal Contarini (De immortalitate animae, adversus Petrum Pomponatium [1518]) rejected both Averroist and Alexandrist versions, as did the church in the Lateran Council on December 19, 1512, as Leibniz later points out. Cassirer (BC., II, 49, n. 314) cites Sponde, Annales ecclesiae, as the source of Leibniz's error. The Naudaeana of the French bibliographer and librarian of Queen Christine of Sweden, Gabriel Naudé (1600-1653), had appeared in 1701.

245. On the quietists, Valentine Weigel, and Angelus Silesius see n. 81 and Vol. I, n. 301.

246. Gen. 1:2. On Henry More see n. 103; on the elder Van Helmont's popularization of Paracelsus' doctrine of archeus, n. 60 and Vol. I, n. 352. On the vitalistic movement see n. 189.

247. "Nothing is in the intellect which has not already been in the senses—except the intellect itself."

248. The capable observers alluded to are Malpighi, Leeuwenhoek, and Swammerdam. Malpighi had formulated the cell theory in his Anatome plantarum (1675), Leeuwenhoek discovered spermatazoa, and Swammerdam was known for his studies of the transformations of insects. On the controversy between the ovulist followers of Harvey and the animalculists following Leeuwenhoek, Leibniz does not here take a position (see Wundt, Leibniz, pp. 54-56).

249. See n. 115.

250. Especially in the articles on "Averroes" and on "Spinoza."

No. 59. REFLECTIONS ON THE COMMON CONCEPT OF JUSTICE

251. Republic 338c ff. Note the change in Leibniz's opinion since 1666 (Vol. I, No. 1, I), when he applied Hobbes's theory of justice to God.

252. De cive xv. 5.

253. Ibid. 16.

254. "In a free state the passing of wind and belching should be free." The ruling of Claudius is reported by Suetonius, chap. 32; Leibniz's bit of vulgarity is of a kind which Sophia seems to have enjoyed.

255. This reaffirms the position taken in the Mainz period around 1670 (Vol. I, No. 6, I).

256. See No. 44, I, above.

257. "What you do not wish to have done to you." This is the Golden Rule in its negative formulation (cf. Matt. 7:12; Luke 6:31).

258. Leibniz's method of reasoning is an application of his law of continuity to cases of justice, arranged from the narrowest legal concept (neminem laedere) in a continuous scale to the highest religious demands. Hence his device of seeking middle cases between the given cases, in which there may be disagreement; this approximates the method which he employed, for example, in his criticism of Descartes's laws of motion (No. 42).

259. "What you do not wish to have done to you (or what you do wish to have done to you), do not do to others (or do not deny to others)." The advance of the argument beyond the negative statement in n. 257 is obvious.

260. "Man is a god to man; man is a wolf to man." Symmachus Epistle ix, 114; Plautus Asin. ii, 4. 90.

261. According to Suetonius, chap. 30; Euripides' original lines are in the Phoenissae v. 524-25. Way translates, "If wrong e'er be right, for a throne's sake were wrong most right."

262. De officiis iii. 6. 17.

263. This flattering example is obviously addressed to the Electress Sophia, for the three queens are those in whom that ambitious sovereign might well be most interested—her mother, the English ruler to whose throne her own right had been established, and her daughter, the Queen of Prussia.

264. See n. 76 for the source of these maxims: "To live honorably (i.e., uprightly, piously), to give to each his due, to injure no one."

265. Nic. Ethics v. 1. 19.

266. Robert Filmer's Patriarchia, or the Natural Power of Kings, derived royal sovereignty from patriarchal authority. His theory evoked Locke's Treatises on Government (1689).

267. "The more law, the more injustice." Cicero (*De officiis* i. 10. 33) has *summum ius, summa iniuria*.

268. *De cive* ii, 5.

269. *Leviathan*, chap. 21.

270. *Ibid.*, chap. 29.

No. 60. REPLY TO THE THOUGHTS . . . IN THE SECOND EDITION OF MR. BAYLE'S CRITICAL DICTIONARY

271. See No. 47.

272. See No. 52.

273. Violent action, in the Scholastic sense, is action proceeding not from an internal cause but from an extraneous source.

274. See Vol. I, No. 36; Vol. II, No. 38.

275. *Phaedo* 60 *b*, *f*.

276. See Vol. I, Nos. 30 and 35 (*Discourse*, Sec. 9); also n. 283.

277. François Lami had attacked various aspects of the theory of pre-established harmony in the *Connoissance de soy-même* (Paris, 1699); Leibniz finally published a partial reply in the *Supplément du Journal des savants* in 1709 (G., IV, 572-95).

278. *De ipsa natura* (No. 53), the reply to John Chr. Sturm.

279. For Simon Foucher see Vol. I, No. 11, and the introduction to No. 47. The allusion is probably primarily to his *Histoire des académiciens* (1690). He had died in 1697.

280. "I have anticipated everything and gone through it in my mind."

281. *Reculer pour mieux sauter.* This is a favorite figure of Leibniz in interpreting the role of evil in history.

282. In his article on Manicheism, Bayle had formulated a dualistic theory of good and evil; much of the discussion in the *Theodicy* later is directed at Bayle's further development of this position. Jean le Clerc, French refugee and editor of the *Bibliothèque choisie*, had replied to the article on Manicheism in a chapter of his *Parrhasiana* (1699), putting his answer in the mouth of an Origenist.

283. See Vol. I, No. 37.

284. See No. 56, II, and GM., V, 350 ff.

285. On Steno see Vol. I, No. 23, introduction and n. 203. John Swammerdam became an enthusiast and follower of Mme de Bourignon.

286. See No. 49. Most of De Méré's letter to Pascal is reprinted in Bayle's article on Zeno.

No. 61. CONSIDERATIONS ON VITAL PRINCIPLES AND PLASTIC NATURES

287. In his *Continuation des pensées diversées sur la comète* (1705) Bayle had made passing reference to the "plastic natures" of Cudworth, charging that they served to make atheism easy. The occasion was Le Clerc's publication of selections from Cudworth's *The True Intellectua System of the Universe* (1678) in his *Bibliothèque choisie.* The ensuing controversy ran into 1707, Bayle's side appearing in the *Réponse aux questions d'un provincial.* Vol. III, chaps. 179 ff. (1705), and the *Entretiens de maxime et de Thémiste, ou réponse à ce que M. le Clerc a écrit* . . . (1707).

288. This Regis is not the Cartesian Pierre Silvain Regis (n. 126) but Henri le Roi (1598-1679), who became a critic of Descartes after 1645. Descarte wrote him in January, 1642, that a true "substantial unity" exists between soul and body (*Correspondence*, ed. Adam and Tannery, V, 508-9).

289. The allusion is to Henry More and Cudworth. On More see n. 103.

290. See nn. 60 and 189 and Vol. I, n. 352, on the elder Van Helmont and the vitalistic movement in general.

291. On the younger Van Helmont (Franciscus Mercurius) and his monadology see also n. 198 and the *New Essays,* Part II, chap. xxvii. The Paris metaphysical meditations were probably those of René Fede, *Méditations métaphysiques de l'Origine de l'âme, sa nature, sa béatitude, son désordre et sa restauration*, which appeared anonymously in 1683.

292. Reading *subsistence* for *substance,* with Erd. On the contemporary biological background see n. 248 and Vol. I, nn. 363 and 409.

293. In December, 1703, Lady Masham had sent Leibniz a copy of her father's work. The correspondence between her and Leibniz which followe contained not only a sympathetic discussion of that work but also one of Leibniz's system, probably based on Locke's difficulties with it.

294. "I do not need it, and it does not meet my need."

No. 62. *Letter to Hansch on the Platonic Philosophy*

295. This term, which Leibniz commonly uses for substance in the last period of his thought, is drawn from Aristotle *Physics* vii. 4. 248*b*, 249*a*.

296. Reading *simus* for *scimus.*

297. Reading *ne* (Erd.) for *nec.*

298. See No. 44, I and II, and n. 75.

299. See n. 81.

No. 63. *Correspondence with Des Bosses*

300. For the origins of this doctrine among Jesuit Scholastics see J. Boehm, *Le "Vinculum substantiale" chez Leibniz: Ses origines historiques* (Paris, 1938). It had arisen in answer to an alleged ambiguity in Aristotle's analysis of substance as a combination of form and matter. Taking the totality of a corporeal being in the double sense of a unified essential

nature and of continuous extension, that is, of the totum essentiale and the totum integrale, these thinkers set up a unifying principle which adheres to, but does not inhere in, matter and which is to be regarded as a substantial form determining both composite essence and extension. Needless to say, this principle does not conform to Leibniz's previous application of the doctrine of substantial forms, and the theory is extraneous to his monadism and imposed upon it only with difficulty.

301. In preceding letters (February 14 and April 22, 1709) Des Bosses had raised questions resting in part upon a failure to distinguish between primary and secondary matter in Leibniz's thought. His argument was as follows: (1) Leibniz has said that matter has existed from the beginning of creation; therefore, the entelechies which are inseparable from matter must also have existed from the beginning of creation. (2) Leibniz has also admitted, in De natura ipse (No. 53), that the souls of animals may not have been created until the fourth day, and therefore the matter essential to their nature could not have existed earlier. (3) As a result, the original primary matter will belong to two entelechies and therefore not to the soul alone, or one entelechy will have to be destroyed, contrary to Leibniz's principles. (4) And would not the new monads, with their matter, increase the total amount of mass in the world? And, if so, how can mass be dependent only upon the relative location of the matter inhering in individual monads?

302. This is the date in Dut., but G. gives April 24, only two days after Des Bosses's letter to which it replies.

303. The book against Bayle is the Theodicy, for which Leibniz was seeking a publisher and which appeared the next year. He had written Des Bosses about this project on September 3, 1708, saying that he had intended to give it to him to read before his departure. Des Bosses later prepared the Latin translation, a project supervised by Leibniz to the point of submitting revisions appropriate to the Latin-reading public. This translation was not published until 1719.

On the Popess Jeanne, alleged to have occupied the chair of St. Peter in the obscure period between Leo IV (d. 855) and Benedict III (d. 858), see the extensive article of that title in Bayle's Dictionary. The story was still common in Protestant circles, and Leibniz's study, though not published, was a conclusive refutation.

304. This note was added in Leibniz's copy but probably not sent in the letter.

305. This was in the writings on physics in 1670-71 (see No. 8, I).

306. In the intervening correspondence the problem of the individual nature of composite bodies came to a head when Des Bosses proposed (January 28, 1712 [G., II, 433]) that, though extension does not constitute the essence of a body, it is a real, not a modal, accident and that this presupposes a substantial or constitutive being different from either matter or entelechy. "If you were to grant me this one real accident, I should not fear to consign what remains to modes."

307. On September 8, 1709, Leibniz had written: "To your question about my method of explaining the Eucharist, I reply that there is no place in our opinion, either for transsubstantiation or for consubstantiation of the bread; but only for the view that, when the bread is received, the body of Christ is perceived, and thus that only the presence of the body of Christ is to be explained. I have already explained to Tournemine that a presence is something metaphysical, like a union, which is not to be explained through phenomena" (G., II, 390).

308. The late Scholastic verb *realizo* and its derivatives, which are so important in defining the substantial chain, Leibniz had called a barbarism in No. 51.

309. Reading *substantia* (Dut., Erd.) for *substantiae* (G.).

310. See n. 303.

311. The interpretation of St. Augustine by Cornelius Jansen (1585-1638), whose *Augustinus* was published posthumously at Louvain in 1640 and became the rallying point of the Jansenist movement, remained controversial in spite of the suppression of the Port Royal group. In his last letter Des Bosses had discussed the condemnation of Jansen's work by the church (G., II, 442).

312. In developing his reply further, Des Bosses quotes at some length the Jesuits Perez (*De incarnatione disputatio*) on the analysis of body and Sebastian Izquierdo on the problem of the *Theodicy*.

313. Cf. *Theodicy*, Preface (G., VI, 29), and Secs. 348-49 and 384 (G., VI, 321, 343).

314. Reading *ratio* for *fatio* (G.).

315. This letter is a reply to one by Des Bosses written August 28, 1712 (G., II, 452-56), in which he argues (1) for a real union which actuates the monads constituting a horse, for example, and further (2) that this unifying being is a nonmodal accident. His specific arguments are clearly restated by Leibniz.

316. This is another reference to the Latin version of the *Theodicy*.

317. Leibniz's marginal note: "The concrete can be distinguished into the accidental (as warm, warm man) and the substantial. The substantial I divide further into simple substances, such as God, angel, soul, and substantiated beings. Substantiated beings are divided into unities per se or composite substances, and unities *per accidens* or aggregates."

318. Reading *cursu* (Dut.) for *ursu* (G.).

319. Of December 12, 1712 (G., II, 462 ff.).

320. As the following letter shows, Leibniz did not at once return home from Vienna. On August 23, 1713, he wrote to Des Bosses: "I am preparing for the journey to Hanover, but I do not know by what detours, for Vienna is quarantined for fear of contagion. However I have so far seen no one dying or dead; the plague is raging among the common people where it is fed by terror and squalor. Unless the evil should grow worse, the Emperor refuses to leave, whatever is urged by those who serve this great ruler. But so a supreme ruler acts; he has more than once discussed with me how a society of sciences can be established with its seat in Vienna, but in such a way that it will have members from elsewhere."

321. In his letter of January 19, 1715 (G., II, 491), Des Bosses had reported on a work published in Holland in 1714 entitled *De l'action de dieu sur les créatures*, which contained a new way of defending physical predeterminism on the ground that voluntary acts are not modifications but things.

322. The only known reference in Leibniz's writings to George Berkeley. Kabi

has published a few critical marginal notes from Leibniz's copy of the *Treatise concerning the Principles of Human Knowledge* in the *Sitzungsberichte d. Preuss. Akad. d. Wis.*, 1932.

323. The correspondence continued until Leibniz's death, but the essential issues and arguments have appeared at this point.

No. 64. CONVERSATION OF PHILARÈTE AND ARISTE

324. An English translation of Malebranche's work, with the title *Dialogues on Metaphysics and Religion,* was edited by Morris Ginsberg in 1923.

325. As the correspondence with De Volder had shown, Leibniz differed from Descartes and Spinoza (who is here alluded to) in conceiving substance, not as static and incapable of change, definable by internal attributes, and unaffected by its modifications, but as functional in both mathematical and dynamic senses of that term and therefore logically compound and analyzable.

326. This parallels the discussion with Des Bosses, at the time when Des Bosses sought to defend nonmodal and real accidents (see particularly n. 317).

327. Compare Leibniz's distinction between formal and exigent necessity in the correspondence with Des Bosses. The relation of the distinction to that between truths of reason and of fact is obvious.

328. See n. 214. This distinction corresponds to that between internal properties or accidents and the external relations (sometimes determined by the perceiving mind and sometimes by the related monad), which Leibniz made in the correspondence with De Volder, Des Bosses, and elsewhere (cf. n. 222).

329. The passage beginning with "that there is no subject . . ." is omitted in G.; this reading follows the collated text in Schmalenbach (Sch.).

330. See n. 295.

331. Following Dut. and Erd.; G. omits *essentiellement.*

332. With Dut. and Erd.; G. has *pur accident.*

333. Thus Leibniz reaffirms his phenomenalism at the very time of his discussion of the *vinculum substantiale* and the real nature of bodies with Des Bosses.

334. Sympathism refers to the Newtonians, who interpret gravity as action at a distance, following the first edition of the *Principia.* Leibniz here includes them with the "neovitalists," as his term *nouveaux archealistes* might be rendered (see n. 189).

335. Nicolas Hartsoeker, in the service of the Elector Palatine at Düsseldorf, had corresponded with Leibniz since 1706. His *Éclaircissemens sur les conjectures physiques* appeared in 1710, reviving the old controversy about atoms. Leibniz had recently written him (October 30, 1710), arguing that atoms are fictions (G., III, 504-10).

336. The latter view was that of Huygens in the correspondence of 1692-94 (cf. No. 43).

337. Like Malebranche, Leibniz believed that our perceptions are based on eternal ideas; but, far from conceiving these ideas as objects (save in

reflection), he viewed them as the possibilities or forms of perception.

338. This sentence did not appear in the published version, and therefore not in Dut. and Erd.; G. gives it from the manuscript.

339. G. has infinie.

No. 65. REMARKS ON THE THREE VOLUMES ENTITLED CHARACTERISTICS OF MAN, MANNERS, OPINIONS, TIMES, . . . 1711

340. Many of his notions about the North American Indians, Leibniz had gleaned from the Baron Louis Armand de la Hontan (1666-1715), author of the Dialogues curieux entre l'auteur et un sauvage de bon sense qui a voyage, et mémoires de l'Amérique septentrionale, a work which did much to fix the Romantic notions of the next century. From Leibniz's letters to Bierling (G., VII, 491, 492) it is clear that the Baron, with whom he held conversations in 1710 and 1711, was already becoming a legendary figure.

341. As becomes clearer in the more explicit references which follow, Leibniz still repudiates any concept of disinterested virtue in which the role of individual pleasure is denied—such a view as was defended by Fénelon in the famous debate with Bossuet, on which Leibniz had long since taken a position (see No. 44, I and II, and nn. 75 and 81).

342. Henri, Duc de Rohan, De l'intérêt des princes et états de la chrétienté (1638).

343. The quotation is from Horace Epist. i. 16. 15.

344. "The more content he is in his vices, the less miserable;/Better than the man who struggles, with his rope now taut, now loose" (from ll. 18-20 of the indicated satire).

345. G. gives 225, which is incorrect.

346. On Franciscus Mercurius van Helmont see nn. 198 and 291.

347. Gibbon examines the story in chapter xxxiv of The Decline and Fall of the Roman Empire.

No. 66. THE PRINCIPLES OF NATURE AND OF GRACE, BASED ON REASON

348. On the relation between the two works see C. Strack, Ursprung und sachliches Verhältnis von Leibnizens sogenannter Monadologie und der Principes de la nature et de la grâce (Berlin, 1915). See also Kabitz in Fischer, p. 772.

349. It is noteworthy that Leibniz here refers to compound substances. Prior to the correspondence with Des Bosses he had generally affirmed the phenomenal nature of bodies, and even in it he ascribed to them only a substantiated and semisubstantial nature. It will be noted that his phenomenalism is not made explicit in Nos. 66 and 67.

350. Leibniz's frequent statement that all nature is alive and no monad without a body is not without ambiguity, but his clearest statements, particularly to De Volder and Des Bosses, apply only to the individual monads but not to all composite bodies. Thus every monad is a vital center, but not all composite bodies have a dominant monad; only bodies endowed with life have.

351. On the origin of the distinction between perception and apperception see also n. 242. In the New Essays (II, 9, 4, and 27, 23), where it first appears, the new term is synonymous with consciousness itself, as it is in the Monadology, Sec. 14. Here it is also identified with reflection, or consciousness of the perceptions themselves. This difference has perplexed many interpreters and entered into W. Wundt's attempt to deny the unconscious in Leibniz.

352. That is, analyzable into fewer simple concepts. Something seems to combine being and one.

353. "Eminently" is opposed in Scholastic usage to "formally." Any quality or agency ascribed to God applies to him in a more exalted sense than the analogous quality or agency as known in man, since God's agency is on another level which our experience cannot reach and is therefore not univocal with its human analogue.

354. See No. 46, the Specimen dynamicum, Part I, and n. 97.

355. Reading relevées with Erd.; this agrees with the Monadology, Sec. 25. G. has revelées.

356. For the long history of the figure of the infinite sphere, which Leibniz may have learned from Pascal, or from the German Rosicrucians and theosophists, see D. Mahnke, Unendliche Sphäre und Allmittelpunkt (Halle, 1937).

No. 67. "The Monadology"

357. Leibniz's own manuscripts of this work bear no title, but it has been known by this title since Erdmann adopted it in his edition, following the designation of the first published version, a German translation, in 1720. For further considerations see the introduction to No. 66. The references to the Theodicy were added by Leibniz in the first revision.

358. See n. 125 and Vol. I, n. 368.

359. See Vol. I, n. 280, and the reference there to the Introduction. "Denomination" implies more than "quality" (in Sec. 8, preceding), for it is a logical term and points to an essence or sufficient reason for changing qualities.

360. The internal principle in Sec. 11 is clearly the law of the individual series, or the individual concept; the detail in that which changes is the particular value of this law or concept which constitutes the changing qualities of the monad. The dynamic parallels to the two concepts are primary and secondary force. Leibniz now proceeds further to divide the details (or secondary force) into aspects of activity and passivity and, from another point of view, into perceptions and the appetites which impel them. Thus he offers a more popular derivation of the organic structure of the monad than in the more critical Scholastic discussions with such men as De Volder and Des Bosses.

361. See Nos. 52 and 60 above.

362. G., VI, 41 ff.

363. Memory is thus still considered by Leibniz as a condition necessary for conscious perceptions (cf. n. 242). Leibniz has held to this point since 1670, when memory was used to distinguish between matter and mind (Vol. I, No. 8, I, Sec. 17).

364. The last sentence appears in the first revision; G. has it in a footnote.

365. Since the ontological argument here depends upon the principle (in Sec. 44) that the reality of essences or possibilities must be founded upon existence, this can hardly be regarded as the ontological argument in its purity. Thus the emphasis in the argument has shifted since Leibniz's early period (see Vol. I, Nos. 14 and 20) from a consideration of the possibility of the existence of a perfect being to the existence of possibilities.

366. Pierre Poiret (1646-1719) moved from Cartesianism to a theosophic interpretation inspired by Antoinette Bourignon.

367. The relations between monads are not spatial, of course, and therefore do not differ in distance in the phenomenal sense. As Sec. 61 shows, spatial relations are merely symbolic analogies to the ultimate relations of perception. Distance is here a matter of the number of middle terms intervening in the analysis of perceptions.

368. Leibniz writes σύμπνοια πάντα ; he makes the same citation in the *New Essays*, Introduction (G., V, 48).

369. G. omits the references to the *Theodicy*.

370. G., VI, 40, 44.

371. See nn. 75 and 81.

372. St. Thomas distinguished (*De veritate*, Q. XXIII, a, 3c; *Summa theologica*, I, Q. XIX, a6) between the antecedent and consequent will of God. Leibniz' definitions, which modify Thomas', are found in *Theodicy*, Part I, Sec. 23 God's antecedent will is for the good, absolutely; his consequent will is for the best possible in existing conditions.

No. 68. *Letters to Nicolas Remond*

373. Lucretius *De rerum natura* ii.

374. That is, the Latin schools preparatory to the university. The curriculum of the Nicolai School in Leipzig, while not conforming completely to the medieval *trivium*, still consisted of Latin and Greek, rhetoric, and logic, together with Scholastic theology. Kabitz has shown that Leibniz's memory was at fault in setting his decision at so early an age; he was probably seventeen.

375. *Theodicy*, Part I, Sec. 61; cf. *Monadology*, Sec. 80.

376. The sentence underscored by Leibniz is in Latin.

377. The reference is to *Some Familiar Letters between Mr. Locke and Several of His Friends*, which appeared in London in 1708. It contained

Réflexions de Mr. L. sur l'Essai de l'entendement humain de Mr. Locke, written in 1696 and sent to Thomas Burnet (G., V, 14-19).

378. See n. 335.

379. The reply to Catelan was made, not in a Paris journal, but in Bayle's Nouvelles de la république des lettres, in 1687 (G., III, 407-17).

380. "Aristotle, Plato, and Euripides, all together, have fallen into the depths."

381. See No. 65 for Leibniz's notes on the Characteristics. His earlier comments on Shaftesbury's Letter on Enthusiasm (including the Uses of Raillery) are found in G., III, 407-17.

382. Leibniz's Observations sur le projet d'une paix perpétuelle de M. l'Abbé de Saint-Pierre was published by Des Maizeaux in 1720.

No. 69. Letters to Louis Bourguet

383. The second edition of the Principia appeared in 1713. It was edited by Roger Cotes, one of the ablest and most careful of England's younger mathematicians. The bitterness of the controversy over the founding of the calculus was shown in the Preface and is reflected in this letter.

384. On Fludd see n. 60. Fludd's views were attacked, and a mathematical theory of physical method defended, by both Kepler and Gassendi, the latter in his Epistola exercitatio in qua praecipue principia philosophiae Roberti Fluddi deteguntur (1630).

385. Descartes to Mersenne, April 20, 1646 (Correspondence, ed. Adam and Tannery, IV, 392-94, 397-403).

386. The irreversibility of temporal series is thus implicit in Leibniz's logic of existence.

No. 70. THE METAPHYSICAL FOUNDATIONS OF MATHEMATICS

387. The reference is to an anonymous review of Christian Wolff, Elementa matheseos universae, Vol. I (Halle, 1713), in which are pointed out Wolff's use of Leibniz's definition of similars and his syllogistic proof of the axiom that the whole is greater than any of its parts. Leibniz here puts both ideas into a context of more general principles.

388. See n. 24 and nn. 239, 256, and 258 in Vol. I. Though Leibniz does not here make clear the conditions imposing a maximal determination upon points constituting a straight line, they involve conformality in the sense that any part of the line is similar to the whole, and this conformality includes the property of minimal distance between points. Considered as a definition of a straight line, therefore, his account does not free itself from Archimedes' definition, though it uses a much broader basis—the principle of the extremum.

389. These logical and intensional analyses of Leibniz illustrate the distinction between logical and empirical analysis which he made at the close of the second letter to Bourguet (No. 68, II). This distinction is essential, too, in understanding the point of view of his logic, which moves from perceptual grasp of qualities to the analysis and combination

of essences.

Quality, as contrasted with quantity, is intrinsically determinable (cf. No. 27, III). It must not be confused with sense qualities, however, but must be understood to mean the intrinsic relations between the elements of single mathematical figures or "formulas."

390. For the calculus of similarity see No. 27, III, where these theorems are developed more fully.

391. See Vol. I, n. 120. The relation of part-whole is thus more determinate than that of contained-container, adding to it the requirement of homogeneity (see *New Essays*, Book IV, 17, 8 [G., V, 469], and Cout. L., pp. 305-6).

392. The omitted paragraphs describe more complex functions, those involving infinite series and incommensurables, as well as linear, quadratic, and cubic functions. The whole thus constitutes an analytic derivation of the notion of functionality, in which the homogeneity of all real numbers with one is involved.

393. Or the law of correspondence or of equipollence.

394. An example which Leibniz frequently uses is Euclid's derivation of the area of a circle from that of a circumscribed regular polygon (*Elements* xii. 2), not directly but by proving the absurdity of alternate assumptions.

395. This paragraph, treating a monadic series as a specially determined case of more general mathematical principles, is valuable for studying the relations between logical analysis and phenomenological interpretation in Leibniz. In the case of our perceptions the maximally determined movement is determined by the law of the series; thus the paragraph also identifies the mathematical principle of the extremum or maximum with the axiological principle of the best possible.

396. There follows a more detailed analysis of the solid determined by four points.

No. 71. *The Controversy between Leibniz and Clarke*

397. In *A Collection of Papers Which Passed between the Late Learned Mr. Leibnitz and Dr. Clarke, in the Years 1715 and 1716, Relating to the Princi of Natural Philosophy and Religion* (London, 1717).

398. Clarke supplies the reference to Newton's *Optics*, Question 31. Irregularities in cometal motion led Newton to ascribe loss of energy to collision and to suggest the possibility of a time when "the present system of nature shall want to be anew put in order by its author."

399. The passage referred to is in Newton's *Optics*, Question 20.

400. Clarke's note refers to *Theodicy*, p. 396: "God, according to my opinion, is an extramundane intelligence, as Martianus Capella styles him, or rather, a supramundane intelligence."

401. The clause "In the paper . . . communicate to me" is lacking in Leibniz's manuscript, as are the paragraph numbers, which were supplied by Clarke

402. Leibniz: *ont besoin de son influence continuelle.*

403. Newton had already rejected the view that God is *anima mundi* in the

famous scholium ending the second edition of the *Principia*.

404. Leibniz wrote merely: *leur capacité et bonne volonté.*

405. Clarke gives a reference to the *Theodicy*, pp. 158 and 161.

406. Cf. the *Principia*, scholium to Def. 8, from which Clarke quotes (*Opera omnia*, ed. Horsley [1779], II, 8). Note the assumption that space is something really existent, which cannot be divided without being moved.

407. Clarke here quotes the closing scholium to the *Principia* on God.

408. Leibniz's copy has the note: "Duplicate. Sent to the Princess of Wales, Feb. 25, 1716."

409. Leibniz's notion of metaphysics is thus more inclusive than his monadology but close to Aristotle's science of first principles, including both essence and existence, and therefore the phenomenal principle of causality. At the same time it is more sharply distinguished from mathematics than in his first period, when he regarded number as a metaphysical ultimate. The steps in this separation were, first, the subordination of mathematics to the universal characteristic and, then, the separation of dynamics from geometry and phorometry.

410. "A barbarism of the Scholastics, who sometimes ape the Greeks. The latter say ἀιθητήριον, from which the former make sensiterium, for sensorium, that is, for the organ of sensation." Rudolf Goclenius (1547-1628) professor at Marburg, published the *Lexicon philosophicum quo tanquam clave philosophiae fores aperiuntur* in 1613.

411. Clarke's example, assuming an indifference of spatial arrangements of the same elements, runs counter, of course, to Leibniz's view that their spatial properties are intrinsic denominations of things and merely abstracted from their dynamic properties, a view which he had used in his theory of relative force and motion. The fundamental difference in the two men's approach, Clarke assuming the independence and ultimacy of spatial relations, Leibniz their abstract and dependent nature, is never resolved.

412. Clarke's note: "This was occasioned by a passage in the private letter wherein Mr. Leibnitz's third paper came enclosed." (G. did not find this letter among the Leibniz papers.)

413. Leibniz, too, recognized a distinction between space and situation but regarded both as subject to the same logical-phenomenological analysis and not as paralleling the distinction between space and matter (see nn. 214, 227, and 328 and the definition of situs in No. 70).

414. Clarke notes: "God is omnipresent not only virtually but substantially, for powers cannot subsist without a substance. Newton's *Principia*, general scholium at end."

415. Clarke notes: "The word active force signifies here nothing but motion, and the impetus or relative impulsive force of bodies arising from and being proportional to their motion. For the occasion of what has passed upon this head was the following passage." (Here Clarke again quotes the passage from the last question of the *Optics* describing the diminution of motion.)

416. Sentence omitted by Clarke: "I was right in quoting the philosophical

dictionary of this author to show the usual sense in which the word sensorium is taken; this is what dictionaries are for."

417. Leibniz's copy adds: "and which they try to avoid in philosophizing."

418. Clarke again quotes the general scholium of Newton's Principia on God.

419. The reference is to Newton's account of the loss of motion in the collision of inelastic and imperfectly elastic bodies; he infers the necessity, therefore, of active principles affecting matter from without (somewhat in the tradition of Leibniz's own early arguments for mind) and suggests that gravity may be such a principle. Active force and passive matter are therefore mutually exclusive for Newton; for Leibniz they are two aspects of force itself.

420. Clarke ends his letter with a note on Leibniz's postscript which G. omits: "N. B. The arguments alleged in the postscript to Mr. Leibnitz's fourth paper have been already answered in the foregoing replies. All that needs here to be observed is that his notion concerning the impossibility of physical atoms (for the question is not about mathematical atoms) is a manifest absurdity. For either there are or there are not any perfectly solid particles of matter. If there are such, then the parts of such perfectly solid particles, taken of equal figure and dimensions (which is always possible in supposition), are physical atoms perfectly alike. But if there be no such perfectly solid particles, then there is no matter at all in the universe. For the farther the division and subdivision of the parts of any body is carried, before you arrive at parts perfectly solid and without pores, the greater is the proportion of pores to solid matter in that body. If therefore carrying on the division in infinitum, you never arrive at parts perfectly solid and without pores, it will follow that all bodies consist of pores only, without any matter at all; which is a manifest absurdity."

421. Cf. Theodicy, Part III, Secs. 301-20.

422. The meaning of this paradoxical sentence is found in Leibniz's doctrine of freedom, according to which the spontaneous (i. e., self-determined) act of a rational monad is entirely consistent with the natural contingency (or temporal determinateness) of the world which God has chosen as the best of all possible ones. Freedom in this sense is therefore entirely consistent with God's election of each individual law as the best of all possible individuals within the conditions of the entire contingent system (see Vol. I, No. 29).

423. Cf. Theodicy, Part III, Sec. 310. Note that Leibniz does not here, like Kant, identify will with practical reason.

424. These meanings of fate are analyzed in the Preface to the Theodicy.

425. This is, of course, only an empirical consideration, not bearing directly on the principle as applied to monads. But phenomenal relations imperfectly represent an infinity of real ones.

426. Clarke's solution of the old issue is Thomistic in the sense that this principle is matter; Leibniz's, on the other hand, is an extension of Scotism in that individuality is the result of the combination of a number of logical possibilities, themselves indeterminate, into a determinate concept or notion.

427. The pragmatic way in which Leibniz uses the principle of sufficient reason here and elsewhere, is noteworthy. A theory like Newton's conception

of gravitational force is "impracticable" when it does not provide a sufficient reason for observable differences in facts or if it provides a sufficient reason for supposed facts which contradict experience.

428. See Principia philosophiae, Part I, 26, 27.

429. Leibniz's correspondence with Guericke on vacuums and other problems is given in G., I, 93-112.

430. The sentences in parentheses are in Leibniz's copy of the letter but are printed by Clarke as footnotes.

431. Sections 36-48, particularly Sec. 47, give one of the clearest of Leibniz's analyses of the relations of situation, space, and body, in terms both of Scholastic categories and of Leibniz's own new relational analysis. In part it repeats, in part supplements, the logical analysis in the preceding work (No. 70). The relational and abstract nature of space finds clear expression, and the reader must not lose sight, not merely of the a priori nature of space, as formal possibility demanding empirical content in order to determine existence, but also of its basis in metaphysics and in the Leibnizian theory of logical form.

432. This reformulates, for spatial relations, Leibniz's doctrine of the intrinsic nature of all denominations. There are no freely floating qualities and relations such as neorealism held to.

433. For earlier analyses of the abstract nature of situation and space see Nos. 54, 62, and 63 and nn. 214 and 328. Leibniz's derivation of space perception here may be contrasted with Berkeley's in being, not psychological, but logical and existential, with an empirical or "phenomenological" test for the truly existent as opposed to the fictional reification of abstractions with which he charges his opponents. The theory of space and situation is thus, on the one hand, a more empirical and determinate application of the universal characteristic and logic of relations and, on the other, an analysis of the forms constitutive of perception and of their limitations.

The functional notation would have served Leibniz (as it would Euclid in the example mentioned) to universalize his theory of the pragmatic nature of relations. The three interpretations of the relation between L and M would then be $L = f(M)$; $M = f(L)$; and $f(L, M) = 0$.

434. Cf. New Essays, II, 14, Secs. 25-26, and p. 17.

435. This application of the principle of indiscernibility to phenomena brings Leibniz close to Kant's phenomenalism, since possible experience is the decisive mark of existence. But Leibniz would not have subordinated geometry and algebra to the forms of space and time, as did Kant (cf. Secs. 54 and 129 below).

436. See n. 337.

437. The logarithm of a ratio can be expressed as the difference between the logarithms of its two terms: $\log (a/b) = \log a - \log b$.

438. Leibniz's fuller analysis of the possibilities regarding the beginning of the universe in time are found in the letter to Bourguet, August 5, 1715 (No. 69, II). Here as elsewhere, however, merely logical considerations do not entirely determine existence (see n. 441).

439. "As if a painter tried to join the neck of a horse to the head of a man."

440. G. has *duratio* for *destructio.*

441. Leibniz thus arrives at an assertion of a finite beginning of creation on theological grounds (Clarke's and his own belief in uniform growth in perfection), not on logical.

442. Cicero *De fato* chap. xvii.

443. Leibniz here interprets the occasionalists as developing their view in correction of the Scholastic doctrine of intentional species transmitted by the body to the soul. For the sources see Thomas, *Contra Gentiles* i. 46; ii. 59; *Summa theologica* i. 85. 2, etc. (see n. 368 in Vol. I).

444. The phrase in parentheses inserted by Clarke has no support in Leibniz's original; his sense seems to have been: "and raises them to the highest level."

445. See the second reply to Bayle in 1702 (No. 60).

446. G. inserts *avec choix*.

447. The words in parentheses are added by Clarke.

448. The transfer of energy from macromasses to their internal molecules is inferred by Leibniz as a result of the conservation of force (see No. 46, I, for a fuller exposition, in relation to the principle of the conservation of internal, relative force).

449. On the distinction between Leibniz's theory of inertia and Newton's see n. 210.

450. "To live on acorns when fruit has been discovered." Leibniz's criticism, here and in what follows, of Newton's theory of gravitational attraction overlooks entirely Newton's clarification in the closing scholium of his second edition and the sharp delineation which results between the methods of physics and of metaphysics. Throughout the controversy Leibniz seems to be conscious of the influence of Henry More upon Newton's earlier speculations. The view that space is indivisible is traceable to him.

451. For Leibniz's appreciation of Robert Boyle (1626-91) see No. 52 and the *New Essays*, IV, 12, 13, where he expresses approval of Boyle's mechanistic principles but denies that they can be established on the basis of experience alone (G., V, 437).

452. *Clélie* (1656) was written by Mlle de Scudéry; *Aramena* (1669), by Duke Anton Ulrich of Brunswick-Wolfenbüttel, as whose librarian Leibniz served. Leibniz's perception of the change of taste at the turn of the centuries was acute.

453. For Leibniz's theory of preformation see Nos. 58 and 60 and Vol. I, Introduction, Sec. VIII.

454. This empirical justification of the principle of sufficient reason, considered along with Leibniz's rejection of the possibility of any "pure" empiricism, is an instance of Leibniz's twofold method, a posteriori and a priori.

455. Clarke's fifth reply, probably written after Leibniz's death, is here omitte

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